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NUCLEAR SCIENCE ABSTRACTS

GENERAL AND MISCELLANEOUS

13876 (BMI-1603(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING NOVEMBER 1962. Russell W. Dayton and Ronald F. Dickerson (Battelle Memorial Inst., Columbus, Ohio). Dec. 1, 1962. Contract W-7405-eng-92. 77p.

Progress is reported in investigations concerning reactor materials and components, fuel materials for the reactor development program, evaluation of PuN materials for fuel, general fuel development, radiation applications, filter evaluation by use of tracers, NPR materials, coated-particle fuel materials, fluoride volatility-process corrosion, creep-rupture in SAP alloys, fission product deposition, radiation effects on MGCR fuels, ML-1 development, F-48 Nb alloy development, and fabrication of Fe–Mo alloys. (J.R.D.)

13877 (HW-76138) HANFORD FORMAL RESEARCH AND DEVELOPMENT REPORTS, 1962. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 1963. Contract AT(45-1)-1350. 41p.

A bibliography of research and development reports published during 1962 is presented. (J.R.D.)

13878 (KR-36) QUARTERLY PROGRESS REPORT [ON ACTIVITIES AT INSTITUTT FOR ATOMENERGI] JULY–SEPTEMBER 1962. (Norway. Institutt for Atomenergi, Kjeller). Jan. 1963. 48p.

In JEEP five of the fuel elements containing natural uranium, showed defects and had to be replaced by two 1.7% enriched UO_2 elements. At the same time two new safety rods were installed. The containment of the new reactor JEEP II was leak tested and the leak rate was found to be less than the specified 0.5% of the contained volume per day at an overpressure of 0.15 kg/cm^2. Experiments were performed in NORA with a mock-up of the JEEP II core. On the basis of these experiments, the physics parameters of JEEP II are determined. The work on the machine code for calculation of neutron thermalization in a cylindrically symmetric heterogeneous reactor cell was continued. It was possible to simplify some of the expressions which have reduced the time needed for the calculation. The REDERIATOM design study of a tanker with a direct cycle boiling water reactor for propulsion was continued. Four engineers participated in a preproject study based on a Norwegian proposal for a joint European nuclear ship project under the auspices of the European Nuclear Energy Agency of the OECD. The construction of the high-pressure boiling loop continues and the 900 kw d-c generator power supply is being installed. A new device for changing the spin of monoenergetic polarized neutrons has been connected to a crystal spectrometer. The method is based on the use of radio-frequency nuclear magnetic resonance. A theoretical investigation was made on the influence of crystal lattice periodicity on the angular correlation of the gamma quanta emitted in positron annihilation in metals. The corrosion study of nickel-plated mild steel in high temperature water and steam with varying oxygen content has continued. Specimens exposed to water and steam with a high oxygen content behaved satisfactorily. The production of six BR-3 type elements for EUROCHEMIC continues. The reprocessing plant has been shut down for alterations during this period. The work on separation and determination of tetravalent plutonium for analytical purposes by means of partition chromatography is continuing. Further experiments were done for extraction of plutonium(IV). The investigation of the physical chemistry of amine extraction systems proceeds. The investigations of methods for improved production of colloid solutions of yttrium-90 and gold-198 for medical purposes have continued. (auth)

13879 (TID-17943) QUARTERLY PROGRESS REPORT NO. 68 [ON ELECTRONICS]. H. J. Zimmermann, G. G. Harvey, and W. B. Davenport, Jr. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). Jan. 15, 1963. Contract AT(30-1)-1842. 154p.

Research is reported on electronics, spectroscopy, chemistry, optical and infrared masers, molecular beams, radio astronomy, plasma dynamics, communication theory information transmission, linguistics neurology, sensory mechanisms, circuit theory, computer theory, and stroboscopic phenomena. (J.R.D.)

13880 RADIATION ENVIRONMENT FOLLOWING A NUCLEAR ATTACK. R. A. Porter and R. L. Hatfield (Martin Co., Denver). AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 240-2(Jan. 1963).

A description is given of an analytical model that can predict postblast nuclear radiation levels following an air burst of any size and proximity. An attempt is made to assemble in one place all the salient subexpressions and considerations that must be incorporated into a computer program for complete prosecution of the model's details. The initial condition assumed is that an overhead nuclear detonation, sufficiently high to preclude significant fallout, has just occurred. An oblate, spheroid-shaped cloud is rising, growing, and emitting gamma rays at an ever-decreasing rate. The radiation dose rate at any discrete time i and altitude j is then calculated. A sample case of a 20-Mt burst is considered, and curves of dose rates vs altitudes at several discrete instants in time are generated. (auth)

BIOLOGY AND MEDICINE

General and Miscellaneous

13881 (BNL-6744) THE HISTORY OF THE BROOKHAVEN BIOLOGY DEPARTMENT MOUSE COLONY NO. 1 (SWISS-BRIDGE-BAGG-O'GRADY-WALTER REED STRAIN) WITH ENDEMIC OCCULT CEREBRAL ENCEPHALITOZOÖNOSIS AND COLONY NO. 2. J. R. M. Innes and G. Borner (Brookhaven National Lab., Upton, N. Y.). [1962]. Contract [AT(30-2)-Gen-16]. 21p.

The history of the first mouse colony of the Brookhaven Biology Department is reviewed. The care, feeding, and pathogenic conditions observed are discussed. (C.H.)

13882 (HW-SA-2653) DETECTION OF PLUTONIUM IN VIVO BY WHOLE BODY COUNTING. W. C. Roesch and H. E. Palmer (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [June 26, 1962]. Contract [AT(45-1)-1350]. 11p.

Plutonium can be detected at depths within a body from which the alpha particles cannot penetrate by detection of x and gamma rays emitted from Pu and its daughter products. Proportional counters and thin-crystal scintillation counters were employed for this purpose. (auth)

13883 (TID-16890) ONSITE ECOLOGICAL RESEARCH OF THE DIVISION OF BIOLOGY AND MEDICINE AT THE OAK RIDGE NATIONAL LABORATORY. Stanley I. Auerbach, comp. and ed. (Oak Ridge National Lab., Tenn.) and Vincent Schultz, comp. and ed. (Division of Biology and Medicine, AEC). Oct. 1962. Contract [W-7405-eng-26]. 159p.

The radiation ecology research program at Oak Ridge National Laboratory is reviewed. The area contains a variety of terrestrial and aquatic habitats that have received an input of radioactive materials. Emphasis is placed on processes involved in the movement and behavior of radionuclides and other chemical elements in natural ecosystems such as forests, fields, and rivers. Laboratory and field studies make use of radioactive tracers and waste radionuclides to determine uptake, accumulation, and movement of isotopes in terrestrial and aquatic food chains; the rates of translocation in plants; consumption of food and turnover of isotopes by terrestrial and aquatic insects and other invertebrates, fish, and mammals; reentry of nutrients and isotopes into the soil through breakdown of organic litter by fungi, bacteria, and soil animals; and the effects of ionizing radiation on organisms, populations, and ecosystems. So far no definite proof of significant damage by radiation from nuclear operations has been found under field conditions at Oak Ridge. (C.H.)

13884 (TID-17894) ALPHA RADIOGRAPHY WITH POLONIUM AND PLUTONIUM SOURCES. Annual Report, 1962–1963. Leonard F. Belanger (Ottawa. Univ.). Contract AT(30-1)-2779. 21p.

Efforts during the report period resulted in improvements to the Po sources. Three such sources are in operation providing alpha radiographs of very good definition. Modifications of technical procedures for alpha radiography and x-ray microradiography are described. Techniques for embedding and cutting tissue specimens are also described. Observations concerning the older regions of cancellous and compact bone from chick, rat, dog, and man are discussed along with factors affecting osteolysis. Photographic plates and alpha radiograms are included. (J.R.D.)

13885 (TID-17931) A SEARCH FOR ANTIMUTAGENS. Final Report. Geoffrey E. Plunkett, Robert A. Rippere, and Francis E. Reinhart (Biochemical Research Foundation, Newark, Del.). Dec. 12, 1962. Contract AT(30-1)-2295. 26p.

Progress is reported in studies on spontaneous mutations in Escherichia coli. Emphasis was placed on the detection and assay of potential antimutagenic agents. Methods for antimutagen screening were refined and new techniques were studied. Over 150 chemical compounds were tested by the use of these systems and a few, showing some evidence of possessing antimutagenic activity were detected. Methods for rapid, large scale screening were devised and applied to the preliminary screening of some 500 compounds representing selected chemical groups. Study of the effects of environmental factors on streptomycin-dependent cell growth in the presence and absence of streptomycin was continued. The value of the Coulter Counter as applied to several bacteriological problems was demonstrated. A review and evaluation of the entire project over the past four years is presented. (C.H.)

13886 (TID-17958) BIOLOGICAL, CHEMICAL AND RADIOCHEMICAL STUDIES OF MARINE PLANKTON. Reference No. 63-4. Progress Report. Bostwick H. Ketchum (Woods Hole Oceanographic Institution, Mass.). Feb. 15, 1963. Includes Appendix, covering period January 1 to December 31, 1962. Contract AT(30-1) 1918. 23p.

Results are reported from biological, chemical, and radiochemical studies on marine plankton collected in the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico. Observations were made on the distribution of nutrient salts in sea water in relation to plankton populations. Measurements were made on the concentration of inorganic and total phosphorus, nitrate, nitrite, and ammonia. Data are included on metabolism in the marine nitrifying bacterium Nitrosocystis oceanus and phosphorus metabolism in Phaeodactylum tricornutum. The nutrient cycle in relation to primary productivity in ocean waters was studied. (C.H.)

13887 MYXEDEMA FOLLOWING RADIOACTIVE IODINE THERAPY OF HYPERTHYROIDISM. Robert L. Segal, Solomon Silver, Stephen B. Yohalem, and Sergei Feitelberg (Mt. Sinai Hospital, New York). Am. J. Med., 31: 354-64(Sept. 1961).

The incidence of inadvertent induction of myxedema was investigated in 1603 patients with hyperthyroidism treated with radioactive iodine. Doses of I^{131} had been administered to give ~100 μc I^{131} retained per g of estimated thyroid weight. In 112 patients (8%) myxedema was present at the time of their final evaluation 1 to 8 yr after the completion of therapy; 1252 patients were euthyroid. In 103 additional patients, transient myxedema, which did not require the permanent use of supplemental thyroid medication, developed. Analysis of the factors influencing the myxedema rate showed that the incidence of myxedema was higher: in young patients, when I^{131} was given after previous surgery or x-ray therapy, in patients with smaller glands, in those with short duration of disease or goiter, or when a smaller number of doses of I^{131} was required for cure. Factors that tended to lower the incidence of myxedema were: previous therapy with antithyroid drugs or iodine, large thyroid glands, and larger number of doses required for cure. (P.C.H.)

13888 TOTAL-BODY IRRADIATION AND MARROW TRANSPLANTATION. Patricia Arnold (Oak Ridge Inst. of Nuclear Studies, Tenn.). Am. J. Nursing, 63: 83-8 (Feb. 1963).

A description of the nursing techniques involved in whole-body irradiation and bone marrow transplantation in leukemic patients is presented. Discussion is given on selecting and preparing the patients, irradiation procedure, bone marrow aspiration and infusion, and post-treatment clinical picture and nursing care. (P.C.H.)

13889 EFFECT OF PARASYMPATHETIC STIMULANTS ON Ca^{45} TRANSFER IN VITRO IN RAT PAROTID GLANDS. Robert H. Dreisbach (Stanford Univ., Palo Alto, Calif.). Am. J. Physiol., 204: 497-500(Mar. 1963).

The effect of parasympathetic stimulants on the uptake and loss of Ca^{45} by rat parotid glands in vitro was studied. Acetylcholine increased rate of entry of Ca^{45} during a 10-min exposure, as shown by increase in the residual radioactivity remaining in glands after washing for 1 hr in non-radioactive media containing atropine. Both pilocarpine and acetylcholine increased the rate of loss of Ca^{45} from rat parotid glands when glands previously exposed to Ca^{45}-containing media were repeatedly transferred to Ca^{45}-free media. (auth)

13890 REFRIGERATION AND IRRADIATION: AIR COOLING OF THE SKIN FIELD DURING ELECTRON BEAM THERAPY. Edwin J. Liebner (Univ. of Illinois, Chicago). Am. J. Roentgenol., Radium Therapy Nucl. Med., 89: 559-66(Mar. 1963).

The use of air for cooling during irradiation is reported, along with observations made when the skin field temperature was lowered during electron beam therapy to the head and neck. From available materials, a cooling apparatus was designed, which lowered the skin temperature to a mean 58°F. Ice bag and air cooling were compared. The air jet stream cooling was studied in 35 patients and representative examples are given. There was mild to moderate protection of the irradiated skin field and moist desquamation was less commonly seen. (P.C.H.)

13891 A PHYSICAL STUDY OF A STRONTIUM 90 β-RAY APPLICATOR. S. J. Supe and J. R. Cunningham (Ontario Cancer Inst., Toronto). Am. J. Roentgenol., Radium Therapy Nucl. Med., 89: 570-4(Mar. 1963).

An extrapolation chamber was used to obtain the surface dose rate and central axis depth dose for a Sr^{90} eye applicator. Isodose curves were obtained from film measurements. The effective spot size was determined by film as was the size of the active area. Lead sheeting, 0.022 in. thick, was used as a field shaping material. A number of field-limiting diaphragms were made up and the dosage characteristics studied, both with film and with the extrapolation chamber. (P.C.H.)

13892 THE IMPORTANCE TO RADIOLOGISTS OF RECENT ADVANCES IN CYTOLOGY AND CYTOGENETICS. G. E. Moore, T. Ishihara, G. F. Koepf, and Avery A. Sandberg (New York State Department of Health, Buffalo and Medical Foundation of Buffalo). Am. J. Roentgenol., Radium Therapy Nucl. Med., 89: 584-9(Mar. 1963).

The appearance of tumor cells in the peripheral and regional blood in cancer patients and its importance to radiologists are discussed. Data on frequency of tumor cells in the regional and peripheral blood of patients with various cancers are tabulated. (P.C.H.)

13893 THE INFLUENCE OF CHELATE-FORMING COMPOUNDS ON THE REACTIONS OF LEAD IN THE ORGANISM. A. Catsch (Kernforschungszentrum Karlsruhe, Ger.). Arzneimittel-Forsch., 12: 924-30(1962). (KFK-124). (In German)

Experiments were carried out in rats to study the influence of various chelate-forming compounds on the distribution of radiolead in the organism. 2:2'-Bis-[di-(carboxymethyl)-amino]-diethyldisulfide (BADDS) and 2-mercaptoethyliminodiacetic acid (MEIDA) showed the most potent activity, resulting in reduced deposition of lead. The two compounds were found superior in effect to all other substances (including ethylenediaminetetraacetic acid, diethylenetriaminepentaacetic acid, and a water-soluble derivative of dimercaptopropanol). Quantitative analysis of the results obtained indicated that BADDS occupies a specific position in the organism, which is made the subject of a detailed discussion. The activity of all chelate-forming compounds generally decreases under conditions of application at a late stage and isotopic dilution of radiolead. The decorporating effects of BADDS and MEIDA remain satisfactory even under these conditions. The therapeutic range of both substances was inferior to that of the other polyamino acids tested. (auth)

13894 A NOTE ON THE MECHANISM OF ACTION OF RABBIT MUSCLE LACTATE DEHYDROGENASE. John F. Thomson and Jacqueline J. Darling (Argonne National Lab., Ill.). Biochem. Biophys. Res. Commun., 9: 334-6(Oct. 31, 1962).

Reaction mechanisms involved in the action of rabbit muscle lactate dehydrogenase were investigated during experiments on the effect of deuterium on the enzyme system. Results indicate that the mechanism involves one or more ternary complexes. (C.H.)

13895 ASSAY OF TRITIUM AND CARBON-14 IN ANIMAL TISSUES BY LIQUID SCINTILLATION. J. Dulcino, R. Bosco, W. G. Verly, and J. R. Maisin (Study Center of Nuclear Energy, Mol, Belg. and Université of Liege). Clin. Chim. Acta, 8: 58-65(Jan. 1963). (In English)

Mouse organs are digested in hyamine hydroxide methanolic solution and the digest is diluted with dioxane before the addition of a toluene scintillating solution. The vials ready for counting contain up to 155 mg of fresh tissue in a volume of 16 ml. Without digest, with the Packard Tri-Carb spectrometer, the yields of counting of the final scintillating mixture are 50% for C^{14} and 17.5% for H^3. With 100 mg of stomach, intestine, brain, or muscle, the yields are 40% for C^{14} and 5% for H^3. They are half these values with 100 mg of liver, lung, or heart. The chemiluminescence with the Tri-Carb spectrometer is negligible with C^{14}, but a waiting period of 48 hr is necessary for counting H^3. During this time, the vials can stay at room temperature without particular screening from the light. (auth)

13896 EFFECT OF GENOTYPE ON ACCUMULATION OF STRONTIUM-89 IN BARLEY AND WHEAT. D. C. Rasmusson, L. H. Smith, and W. M. Myers (Univ. of Minnesota, St. Paul). Crop Sci., 3: 34-7(Jan.-Feb. 1963).

Fifty varieties of wheat and 48 of barley were studied to determine the amount of genetic variation that exists for Sr^{89} accumulation in the grain. The plants were grown in greenhouse pots containing soil to which Sr was added prior to planting. Sr^{89} was applied with and without stable Sr. Large genotypic differences were found within both barley and wheat. The barley varieties accumulated more Sr^{89} that the wheat varieties, but the range of variation was greater for wheat. The range in accumulation based on 2 experiments was from 42 to 95 dis./sec/g dry matter for barley and from 34 to 110 for wheat. For barley, application of stable Sr (Sr^{88}) had no effect on Sr^{89} accumulation while for

wheat a highly significant decrease in accumulation of Sr^{90} occurred with application of Sr^{88}. (P.C.H.)

13897 PROGRESS REPORT ON THE USE OF RADIOSENSITIZERS IN THE DEPARTMENT OF RADIOTHERAPEUTICS, UNIVERSITY OF CAMBRIDGE. D. B. Cater (Cambridge Univ., Eng.). Giorn. Ital. Chemioterapia, 6-9: 235-9(July-Sept. 1962). (In English)

Synkayvite acts as a radiosensitizer and is selectively taken up by tumor cells in vivo and in vitro. Stable incorporation of tritium into tetra sodium 2-methyl-1,4-naphthaquinol diphosphate was achieved and the effect of the radioactive drug on advanced cancers in patients and in domestic animals was studied in order to assess the clinical value of such drugs. (P.C.H.)

13898 THE QUALITY OF ANTIBODY PRODUCED BY TRANSFERRED CELLS. Howard M. Grey (Scripps Clinic, La Jolla, Calif.). Immunology, 5: 603-9(Sept. 1962).

Comparisons were made of the rate of dissociation of antibody to bovine serum albumin, produced by recipients and donors in cell-transfer experiments, using a salting-out technique. Cells from individual donors were prepared for transfer and injected into either normal adults or adults that had received 400 r whole-body x radiation 24 to 48 hr before transfer. It was found that: antibody formed in most normal and irradiated adult recipients had dissociation rates very similar to those of the donor animals; and antibody formed in most newborn recipients was similar to the antibody formed in the donors with respect to the kinetics of antigen-antibody dissociation. The data support the hypothesis that the recipient animal plays no direct role in the formation of antibody in cell transfer, and that the recipient environment to which the transferred cells are exposed does not appreciably affect the quality of the antibody produced. However, the rate at which γ-globulin synthesis proceeded was subject to environmental factors involving cellular processes in general. (P.C.H.)

13899 THE EFFECTS OF ANTIBIOTICS AND IRRADIATION ON THE PSEUDOMONAS-ACHROMOBACTER FLORA OF CHILLED POULTRY. Margaret J. Thornley, M. Ingram, and Ella M. Barnes (Low Temperature Research Station, Cambridge, Eng.). J. Appl. Bacteriol., 23: 487-98(Dec. 1960).

The effects of antibiotics and irradiation on the growth of Pseudomonas and Achromobacter flora in poultry were investigated. Experiments were performed on chilled eviscerated poultry stored at either 1 or 3°C. Both treatments favored the survival of yeasts, which were eventually outgrown by the bacteria. Pseudomonas was more sensitive to radiation but Achromobacter was more sensitive to tetracyclines. In the antibiotic experiments the ultimate spoilage flora was generally dominated by pseudomonads, but there were significant differences between tetracycline compounds tested. Chlorotetracycline almost eliminated the pseudomonads, only pigmented strains appeared at a later stage; with tetracycline, pigmented strains were abundant; with oxytetracycline, nonpigmented strains dominated throughout, though growth was delayed. Moderate doses of irradiation killed the pseudomonads and spoilage occurred with Achromobacter, although the usual putrid smells were not present. With the combined effects of chlorotetracycline and irradiation, there was an extension of storage life roughly equal to that of the sum for the two separate treatments. (P.C.H.)

13900 COMPARISON OF STIMULUS ENERGIES REQUIRED TO ELICIT THE ERG IN RESPONSE TO X-RAYS AND TO LIGHT. C. S. Bachofer and S. Esperance Wittry (Univ. of Notre Dame, Ind., and Coll. of St. Catherine, St. Paul). J. Gen. Physiol., 46: 177-87(Nov. 1962).

The retina of Rana pipiens, the leopard or grass frog, is shown to be an extremely sensitive detector of x rays. Its sensitivity to x rays equals in some respects its sensitivity to visible light. The energy required for the response to visible light is very low. An exact comparison was made of the amount of energy required in the stimulus to elicit an electroretinogram (ERG) in response to x rays and to light. ERG's from threshold responses to maximal responses obtainable with x rays and light were reproduced. The rods of the retina are shown to be responsible for the production of the ERG. The actual amount of energy absorbed in the rhodopsin from x ray and light stimulation over a wide range of intensities and durations was determined and related to the amplitude of the ERG. The three-dimensional relationship of amplitude of response, intensity of stimulus, and duration of stimulus shows rather unexpectedly that in certain regions light is more efficient while in other regions x rays are more efficient. (P.C.H.)

13901 NEW TECHNIQUE FOR INTERSTITIAL IRRADIATION OF BRAIN TUMORS. James W. Correll, Norman E. Chase, and Harold L. Atkins (Presbyterian Hospital, New York). J. Neurosurg., 18: 800-3(Nov. 1961).

A method for the interstitial irradiation of intracranial neoplasms by the implantation of Ir^{192} is described, and its use in patients is demonstrated. It provides high doses to specific volumes of tumor-containing tissue with limited irradiation elsewhere, making it possible to spare normal tissue and adjacent vital structures. The method supplants the use of Ra needles and Rn seeds. Ir^{192} has the advantage over Co^{60} of emitting much softer gamma rays, which are absorbed locally to a larger extent by tumor tissue and is more easily shielded by lead. The half life (74.37 days) of Ir^{192} is much shorter than that of Co^{60} or Ra, but is long enough in contrast to Rn or Au^{198} to permit storage for over 2 months. Also, I^{192} can be produced in much smaller sizes than Rn or Au^{198} sources. Ir^{192} is used as seeds placed at fixed intervals in fine, flexible, nylon-ribbon carriers. The seeds were made by encasing Ir^{192} in stainless steel. The procedure is carried out under direct vision at the time of craniotomy, the ribbons being inserted in a parallel fashion at a distance as near to 1 cm from each other as possible, to provide all portions of the implanted area with the full calculated dose of irradiation. A tissue dose of 5000-6000 r is achieved in 4-7 days with seeds having an initial activity equivalent to 0.3 to 0.5 mg of Ra. In operations using this technique, the surgeon receives less than 21 mr, the radiologist assisting the surgeon even less, and others show no evidence of exposure. These figures are well below the allowable maximum per week, and with experience can be reduced. (P.C.H.)

13902 HEAVY-PARTICLE IRRADIATION IN NEOPLASTIC AND NEUROLOGIC DISEASE. John H. Lawrence, Cornelius A. Tobias, James L. Born, C. G. Wang, and John H. Linfoot (Univ. of California, Berkeley). J. Neurosurg., 19: 717-22(Sept. 1962). (UCRL-10309)

Discussion is given on complications from heavy-particle irradiation of the brain, pituitary gland, and soft tissues. Studies reported on 237 patients, extending over 15 years, provide background information on the long-term effects of relatively large doses of radiation on the brain. Some neurological complications have resulted in patients who have received relatively large doses of α-particle radiation to the pituitary, especially in patients with advanced cancer of the breast. Advantages of heavy-particle radiation are a large RBE and their relative insensitivity of their effects

to oxygen; thus, the relative anoxia of neoplastic tissue is not an adverse factor. (P.C.H.)

13903 RADIOISOTOPES IN THE PHARMACEUTICAL SCIENCES AND INDUSTRY. John E. Christian (Purdue Univ., Lafayette, Ind.). J. Pharm. Sci., 50: 1-13(Jan. 1961).

13904 A CASE OF BETA RADIATION BURNS. R. Frant (Philips Health Centre, Eindhoven, Netherlands). Med. Mundi, 8: 14-17(1962). (In English)

A case of skin burning on the back of the hand by beta radiation is described. The dose received was of the order of 2.5×10^4 rad. Although treatment was commenced almost immediately, skin transplantation was required. Great vigilance was necessary to prevent contraction and stiffness of the hand. A long-term follow-up was required. (P.C.H.)

13905 DOSIMETRIC TABLES AND CALCULATION OF DOSES FROM FILAMENTOUS SOURCES OF COMPLEX CONFIGURATION. V. A. Petrov (Inst. of Medical Radiology, Ministry of Health, USSR). Med. Radiol., 8: No. 1, 7-12(Jan. 1963). (In Russian)

In the radiological clinic use is made of filamentous sources of gamma radiation of complex configuration, for instance, the so-called flexible needles from Co^{60} preparations and tantalum wire. Usually such a filament introduced into the tissue has a spiral form. A formula that enables the absorbed dose to be calculated in rads in the tissues depending on the general activity, pitch, diameter, and number of turns of the spiral is recommended. A table is proposed where all the dosimetric computations are simplified: the multiplication of only three values – the activity of the source, time of its action, and coefficient from the table – is necessary. (auth)

13906 DOSIMETRIC CHARACTERISTICS OF THE APPARATUS GUT-Co-400. T. G. Pavlova (State Inst. of Roentgen-Radiological Research, Ministry of Health, USSR). Med. Radiol., 8: No. 1, 18-24(Jan. 1963). (In Russian)

Studies were made of the dose fields included in the set of the apparatus GUT-Co-400. The utilization of different methods of assessing the dose distribution in the phantom made it possible to determine precisely the dose fields. On the basis of data derived on the distribution of doses, a confrontation of isodose charts in irradiation of the urinary bladder was carried out by means of the apparatus GUT-Co-400. Recommendations for the choice of the technique of irradiation are given. (P.C.H.)

13907 BONE MARROW STORAGE: CURRENT CONCEPTS. Arthur M. Pappas, Vernon P. Perry, Thomas E. Wheeler, and George W. Hyatt (National Naval Medical Center, Bethesda, Md.). Military Med., 126: 347-54(May 1961).

Procedures for the collection and storage of human bone marrow are described. Two methods of marrow storage were investigated, namely, nutrient media and protective freezing. The marrow is aspirated from the donor, diluted with an equal volume of nutrient solution, collected in a storage vessel, and immediately refrigerated at 4°C. Preliminary results with this type of storage indicate that 75% of the viable cells can be maintained for periods up to 10 days, but attempts are being made to extend this period to 30 days by varying the temperature and composition of media employed during storage. A freezing apparatus is described that permits reproducible freezing of uniform samples of marrow at 1°C per min with a maximum deviation of +0.5°C. Polyhydroxy hydrocarbons and carbohydrate derivatives are used as protective agents during the freezing of viable cells. In the absence of a protective agent or an adequate concentration of the agent, cells removed during freezing and all lower temperatures were uniformly destroyed. Various tests for determining the viability of marrow cells are discussed as well as their use in enhancing survival of irradiated animals. (H.H.D.)

13908 REACTORS FOR MEDICAL PURPOSES. F. Bellini (Università, Milan). Minerva Nucl., 6: 321-6 (Oct. 1962). (In Italian)

Nuclear reactors can be used for therapeutic purposes as well as for medico-biological research. Reactors exclusively for the treatment of heteroplastic conditions have been constructed during the past few years in the United States of America and in Europe. The main structural characteristics of the reactors now in use and of those which are now being constructed are described. Neutron capture therapy, with the use of a beam of thermal neutrons, seems promising in the treatment of cerebral tumors, although no definite conclusions as to the value of this type of treatment can yet be drawn on account of the small number of cases which have been treated so far. (auth)

13909 LONG-RANGE RESULTS OF THE RADIOACTIVE PHOSPHORUS THERAPY OF POLYCYTHEMIA VERA. Sandor Fazekas, Gyorgy Nagy, and Gyula Petranyi (Medical Univ. of Debrecen, Hungary). Orv. Hetilap, 104: 214-16(Feb. 3, 1963).

The results of P^{32} treatment of 22 patients with polycythemia vera are presented. Some patients received a single dose of P^{32}, others repeated doses. In general the therapeutic effect was satisfactory. The average length of remission after the first treatment was 10.8 months. (P.C.H.)

13910 PROGRESS IN MEDICAL GENETICS. VOLUME II. Arthur G. Steinberg and Alexander G. Bearn, eds. Prog. Med. Genet., 2: 1-378(1962).

Nine separate articles are included; 2 were abstracted for NSA. In the 7 articles not abstracted, information is given on: developments in the study of genetically determined human gamma globulin types (the G_M and I_{NV} groups); plasma transferrins; genetic and chemical considerations of the group specific component of serum; hereditary aminoaciduria; antibody synthesis; clinical and immunologic evidence for a predisposition to rheumatic disease in certain families; and ophthalmic genetics. (P.C.H.)

13911 CHROMOSOME ABERRATIONS IN EXPERIMENTAL MAMMALS. Liane Brauch Russell (Oak Ridge National Lab., Tenn.). Prog. Med. Genet., 2: 230-94(Oct. 1962).

A review of work on chromosome aberrations in experimental mammals during the past 10 years is presented. Only chromosomal aberrations in germ cells, or arising from the circumstances of fertilization, are included. Discussion is given on changes that affect entire chromosomes (heteroploidy), including both those involving entire chromosome sets (euploid heteroploidy) and those involving individual chromosomes (aneuploid conditions either of a known or of an unspecified nature); changes that involve additions or deletions of portions of individual chromosomes (duplications and deficiencies); and rearrangements of chromosome material (inversions and translocations). 125 references are given. (P.C.H.)

13912 MAMMALIAN GENETICS IN MEDICINE. Salome Gluecksohn-Waelsch (Albert Einstein Coll. of Medicine, New York). Prog. Med. Genet., 2: 295-330(Oct. 1962).

Approaches and results in the field of animal, specifically mammalian, genetics are singled out that either have contributed to the illumination of problems of medical genetics,

or which show promise of being able to help progress in medical genetics. Problems in genetics of theoretical as well as of practical nature are considered; contributions from the field of mammalian genetics, which advance the solution of the problems, were selected. Discussion is given on the application of concepts derived from experimental genetics, gene effects in mammalian development, transplantation genetics of mammals, sex chromosomes, genetics of mammalian reproduction, genetic pathology of mammals, cancer susceptibility of mice, and genetics of experimental allergic encephalomyelitis. (P.C.H.)

13913 STAINING SECTIONS BEFORE AUTORADIOGRAPHIC EXPOSURE: EXCESSIVE BACKGROUND GRAINING CAUSED BY CELESTIN BLUE. E. M. Deuchar (University Coll., London). Stain Technol., 37: 324(Sept. 1962).

In experiments on the uptake of radioactive amino acids into 2-day chick embryos, 3-μ sections were stained prior to covering them with Kodak Ar 10 Stripping Film. This was found the most satisfactory and convenient procedure when handling large numbers of slides; moreover, it avoided the difficulties of staining and differentiation through the film. Staining with Celestine blue gave much clearer histological results than hematoxylin, but the autoradiographic film on all the slides showed a dense overall graining, which not only made it impossible to detect a count above background in the tissues, but also obscured all histological detail. The reason for the obscurring effect with Celestine blue is unknown. The results also underline the need for careful controls with all staining procedures, since it is possible that other stains may also interact with the film and produce background graining. (H.H.D.)

13914 STRAHLENFORSCHUNG UND KREBSBEHANDLUNG. VORTRÄGE AUS DEN GEBIETEN DER STRAHLENTHERAPIE, DER ISOTOPENFORSCHUNG, UND DER STRAHLEN BIOLOGIE. (Radiation Research and Cancer Treatment. Reports in the Fields of Radiation Therapy, Isotope Research, and Radiation Biology). H. Meyer and J. Becker, eds. Munich, Urban and Schwarzenberg, 1959. 472p.

13915 STUDIES ON IMMUNE REACTIONS IN IN VIVO CULTURES. T. Makinodan, Elmo E. Capalbo, Paul Urso, Franco Celada, Eugene H. Perkins, and Joseph F. Albright (Oak Ridge National Lab., Tenn.). p.73-86 of "Proceedings of The International Symposium on Tissue Transplantation." Santiago, Chile, Universidad de Chile, 1962.

An in vivo culture method was devised with modifications in order to study systematically the mechanism of immune reactions by a simple, rapid, sensitive, reproducible, and quantitative method. With the original model, it was demonstrated that spleen cells undergoing a primary antibody response are as radiosensitive as those undergoing a secondary antibody response. The various modifications were adopted so that the test cells could be contained within a limited volume, in order to quantitatively assay transplantation antigens, and in order to determine whether differences in radiosensitivity existed between the homograft-rejecting and antibody-forming capacities of spleen cells. The various models are presented schematically. (P.C.H.)

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Refer also to abstract 14331.

13916 (ARF-3170-6) TOXICOLOGY OF AURIN TRICARBOXYLIC ACID AND ITS ANTIDOTAL EFFECTIVENESS AGAINST BERYLLIUM. Maurice E. King (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Dec. 1961. Contract AF33(616)-6947. 23p. (AD-272853; ASD-TR-61-674; N62-10124)

Monkeys and dogs were used in a series of studies designed to assess the ability of aurin tricarboxylic acid (ATA) to provide protection against acute beryllium poisoning. The acute LD_{50} of ATA was found to be 344 mg/kg for monkeys and 164 mg/kg for dogs. Neither species exhibited significant hematological changes when given weekly ATA doses of 25 mg/kg over an 8-month period. The lethal intravenous dose of beryllium sulfate was 0.6 mg/kg for both dogs and monkeys, but the value increased to between 1 and 3 mg/kg when given by intratracheal injection. Acute toxic effects were not observed by either intravenous or intratracheal doses of suspensions of beryllium oxide. Treatment with ATA appeared to have therapeutic value in monkeys exposed to beryllium, but no significant response was observed in dogs. (auth)

13917 (HW-SA-2570) STUDIES ON THE EFFECTS OF DEUTERIUM OXIDE ON YEAST. R. T. O'Brien (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [May 4, 1962]. Contract AT(45-1)-1350. 3p.

Deuterium oxide reduced growth rate, respiratory activity, and fermentation in cells of S. cerevisiae grown in a medium containing inorganic salts, vitamins, glucose, and asparagine. Cells were deuterated by the substitution of 99.5% D_2O for water in the medium. Inhibition of growth and respiratory activity were reversed when D_2O grown cells were suspended in water. Possible reaction mechanisms involved in the inhibition of growth by D_2O are discussed. (C.H.)

13918 (HW-SA-2605) EFFECTS OF INGESTED PLUTONIUM-239 ON FECUNDITY, FERTILITY, AND LIFE SPAN OF HABROBRACON (HYMENOPTERA: BRACONDIDAE). H. E. Erdman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [June 8, 1962]. Contract AT(45-1)-1350. 10p.

Groups of virgin female wasps, Habrobracon, were each fed a different Pu^{239} concentration in a single meal which produced estimated intakes of 0.0, 0.02, 0.03 to 0.04, and 0.11 to 0.14 μc Pu^{239}. Effects of fecundity, fertility, and life span were found comparable to those produced by external radiations and by other ingested radionuclides. Plutonium-239 accumulated in eggs. The differential radiosensitivity of gametes was explained by their developmental stage, and suggested chromosomal condensation and behavior were critical factors. (auth)

13919 (HW-SA-2613) COMPARATIVE HISTOPATHOLOGY OF Pu^{239}, Ra^{226} AND Sr^{90} IN PIG BONE. W. J. Clarke (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [May 26, 1962]. Contract AT(45-1)-1350. 20p.

Miniature swine were injected intravenously with either Sr^{90}, Ra^{226}, or Pu^{239} at six weeks, six months, or one year of age to compare the relative toxicity of these radionuclides per se, and to assess the effect of age on the appearance and type of bone lesions. Eighteen months post-injection, samples of rib bone were processed by routine radioanalyses, histopathological, and histochemical methods and examined for radiation damage. It was found that irrespective of age at time of establishment of body burden, Pu^{239} was more damaging to bone than Ra^{226} or Sr^{90}. (auth)

13920 (HW-SA-2626) EFFECTS OF INTRADERMAL INJECTIONS OF PLUTONIUM IN SWINE. J. W. Cable,

V. G. Horstman, W. J. Clarke, and L. K. Bustad (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [June 5, 1962]. Contract AT(45-1)-1350. 16p.

A study of the acute and chronic effects of Pu^{239} deposited in the skin of blond miniature swine was initiated in July 1960. Ten blond miniature swine were injected intradermally with 0.0016, 0.008, 0.04, 0.2, 1, and 5 μc of plutonium nitrate in 0.01 ml of 0.2 N HNO_3. Six additional swine were injected with 1 μc and 5 μc of plutonium nitrate for the determination of distribution and translocation. An additional three swine were injected with Pu^{238}, Pu^{239}, and Np^{237} in order to compare radiation and chemical effects. Control sites were injected with 0.01 ml of the 0.2 N HNO_3 stock solution. External monitoring of the sites indicated that about 70% of the injected Pu^{239} was present eight days post-injection and less than 2% remained in most sites after 565 days. The injection sites showed no visible lesions at the two lower dose levels while inflamed areas containing deep ulcers and a clear to pale yellow exudate were observed at the higher levels. Thirty to approximately 90% of the Pu^{239} at the injection site was lost soon after ulcer formation. Healed lesions were identifiable by the areas of scar tissue, many of which had persistent scabs. Radioanalysis of selected tissues seven days after injection of 1 μc/site animal showed that about 12% of the administered plutonium appeared in the regional lymph nodes, about 7% in liver, and slightly less than 5% appeared in the bone. The amount translocated from the animal injected with 5 μc/site was somewhat less. Histopathological observations of the skin are summarized and the pattern of necrosis in the regional lymph nodules is discussed. Of particular interest were the autoradiographic studies which showed the pattern of plutonium deposition in the skin and regional lymph nodes, and suggested that there was a greater local spreading of the plutonium at the 1 μc than at the 5 μc sites. (auth)

13921 (HW-SA-2879) SOME BIO-MEDICAL APPLICATIONS OF RADIOISOTOPES. L. K. Bustad and R. O. McClellan (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [1961]. Contract AT(45-1-1350. 39p.

Applications of radioisotopes to studies on physiological responses in animals and organ systems are reviewed. Topics discussed in detail include methods for the determination of lean body mass, measurements of body components, measurements of metabolic rate, measurements of lung function, measurements of liver and gastrointestinal function, measurements of pancreatic function, measurements of renal and cardiovascular function, methods for splenic scanning, immunological studies, and applications of radioisotopes in labeling pathogenic organisms and insect vectors. (C.H.)

13922 (IA-748) THE EFFECT OF PYRIDOXAL 5-PHOSPHATE IN THE PRESENCE OF VANADYL IONS ON THE DEIODINATION OF THYROXINE. M. Anbar and M. Inbar (Isarel. Atomic Energy Commission, Rehovoth). July 1962. 5p.

Studies were made to determine whether the pyridoxal phosphate–vanadium complex may affect the rate of deiodination of thyroxine in vivo in mice. One hour after injection of the pyridoxal phosphate and/or vanadium ions, the mice were injected with I^{131} labeled thyroxine. Two hours later, the mice were sacrificed and the amount of labeled protein-bound iodine and of iodide in serum was determined. It was found that whereas pyridoxal phosphate alone has no effect on the rate of deiodination, vanadyl ions have a certain effect of enhancement. However when vanadyl ions were administered simultaneously with pyridoxal 5-phosphate, the catalytic effect of vanadyl ions was doubled. The oxygen consumption rate diminished as the rate of deiodination increased. (M.C.G.)

13923 (AEC-tr-5669) THE BEHAVIOR OF THORIUM DIOXIDE IN THE ORGANISM OF RATS FOLLOWING ITS INTRATRACHEAL ADMINISTRATION. Syao-Shan Yan (Yan Syao-shan). Translated for Los Alamos Scientific Lab., N. Mex. from Gigiena Truda i Prof. Zabolevaniya, 6: No. 10, 46-51(1962). 7p.

Thorium dioxide was found in the lungs, the trachea, the lymph nodes of the pulmonary hili and the neck, the gastrointestinal tract and its contents, the liver, the spleen, the bones, the kidneys, the urine, and the feces during the first five days after its intratracheal administration to rats. Most of the thorium was found in the lungs, comprising 50.3 to 73% of the total administered during the initial period (up to 10 days). Twenty-one months later, the lungs still contained some 30% of the thorium introduced, which is evidence of its prolonged retention in the lungs. Autohistoradiography of the lungs and the lymphatic nodes disclosed an accumulation of thorium and tracks of alpha particles emitted by thorium in the alveolar walls. Thorium is excreted in the feces and urine during the first few days after its administration. The prolonged retention of thorium dioxide in the lungs of animals represents a serious hazard of long-term sequelae of alpha radiation at the sites of thorium deposition. Tumors were found in several animals intoxicated with thorium dioxide. (auth)

13924 THE PHARMACOLOGY OF RADIOPROTECTANT CHEMICALS. BIOCHEMICAL CHANGES IN THE DOG FOLLOWING THE ADMINISTRATION OF BETA-MERCAPTOETHYLAMINE (MEA). Roy L. Mundy, Melvin H. Heiffer, and Benjamin Mehlman (Walter Reed Army Inst. of Research, Washington, D. C.). Arch. Intern. Pharmacodyn., 130: 354-67(1961).

General pharmacological reactions produced by slow intravenous injection of a large dose (100 mg/kg) of MEA in the dog are described. Epinephrine and norepinephrine levels in plasma increased during the early normotensive period and maximum levels were observed with profound hypotension, which occurred 9 to 15 min after the beginning of the administration of MEA. Elevated catechol amine levels persisted for 1 to 2 hr and gradually returned toward control values at the end of 3 hr. Diphenhydramine (10 mg/kg, intravenously, 30 min prior to the administration of MEA) increased the circulating levels of catechol amines; however, it suppressed the expected increase following MEA. Vagatomy also suppressed the expected levels of the catechol amines following MEA administration. Blood glucose increases occurred but later than the catechol amine elevations, and peak values were attained at ~1 hr after MEA injection. Diphenhydramine and surgical procedures, which suppressed MEA-induced increases in epinephrine, also tended to suppress blood glucose rises, and barbiturate anesthesia suppressed the blood glucose increases usually produced by MEA. Hypoxia was present as early as 10 min after the beginning of MEA injection, during the normotensive period. Oxygen capacity of the blood increased slightly, and this was associated with an increase in hematocrit values. Most the effects of MEA can be attributed to release of epinephrine and norepinephrine from the adrenal medulla and the sympathetic nervous system. (P.C.H.)

13925 RADIUM IN HUMAN TEETH. A QUANTITATIVE AUTORADIOGRAPHIC STUDY. R. E. Rowland

(Argonne National Lab., Ill.). Arch. Oral Biol., 8: 13-21 (1963).

Teeth from three cases of radium poisoning were studied to determine the quantity and the location of the radium remaining within them many years after it was acquired. The total radium content of each tooth was determined, and the specific activity of the tooth compared with that of the entire skeleton. Subsequently the concentrations of radium within the various portions of the dental tissues were measured, and the concentrations compared with those found in the bones of the same individual. The role of growth and of exchange processes in the fixation of this radioisotope within the teeth are discussed, and it is suggested that the magnitude of the exchange-deposited radium within the teeth is related to the total skeletal radium content. (auth)

13926 EFFECT OF OXYGEN AND N-ETHYLMALEIMIDE ON THE INACTIVATION OF RIBONUCLEASE BY γ-RADIATION. B. A. Bridges (Atomic Energy Research Establishment, Wantage, Berks, Eng.). Biochim. Biophys. Acta, 67: 331-4(Feb. 12, 1963). (In English)

A 0.01% aqueous solution of pancreatic RNAase was irradiated at room temperature with gamma rays from a Co^{60} source (dose rate about 2.6×10^5 rad/hr). Air, oxygen-free nitrogen, or various mixtures of the gases were bubbled rapidly into the solution through an open-ended tube for 6 min before and throughout irradiation. In some runs N-ethylmaleimide was present at various concentrations. It was found that N-ethylmaleimide (5×10^{-4} M) showed a considerable protective effect under anoxic conditions (N-ethylamaleimide in the absence of radiation did not affect the activity of the enzyme). Oxygen (when air was bubbled through) also exerted a marked protective affect but this was not observed with unbubbled aerobic solutions. The protection observed with N-ethylmaleimide may be due to its acting as a radical scavenger. (P.C.H.)

13927 CONDITIONS FOR THE FORMATION OF AN IODINATED AND TRITIATED PROTEIN COMBINATION DURING THE DEIODINATION OF DOUBLY LABELED I^{131} AND H^3 THYROID HORMONES. Jean Roche, Jacques Nunez, and Claude Jacquemin (Collège de France, Paris). Biochim. Biophys. Acta, 69: 271-83(Feb. 5, 1963). (In French)

Thyroid hormones doubly labeled in α-β position with H^3 and in 3′,5′ or 3′ with I^{131} ([I^{131},H^3]DL-thyroxine and [I^{131},H^3] 3,5,3′-triiodo-DL-thyronine) were deiodinated by mitochondria and several acellular preparations. The only labeled compounds produced under the experimental conditions adopted were I^{131} and a protein complex, PX, which contained both H^3 and I^{131}. Since no H^3 loss occurred during the incubation, there was no exchange between the tritium atoms of the iodothyronine and the hydrogen atoms of the medium. The ratio of the specific activities of the two isotopes in the chromatographic zones where residual DL-thyroxine or 3,5,3′-triiodo-DL-thyronine were located was identical to the blank after incubation with thyroxine deiodinase except where a disagreement was observed in the rate of deiodination calculated from the measurements of I^{131} and H^3. At the end of the reaction PX always contained a fraction of the I^{131} and the total H^3 provided for by the iodothyronine that had disappeared. The I^{131} concentration of PX is not constant during the incubation period. I^{131} deiodination of PX took place in two steps, which seemed to indicate that the I^{131} was present in the protein in two different forms. All the preparations led to the same reaction products. (P.C.H.)

13928 MITOCHONDRIAL FORMATION AND HYDROLYSIS OF ADENOSINE TRIPHOSPHATE IN THE PRESENCE OF SOME RARE-EARTH IONS. Diether Neubert (Johns Hopkins Univ., Baltimore). Biochim. Biophys. Acta, 69: 399-402(Feb. 5, 1963). (In English)

Investigations were made to determine whether the toxic effect of rare earths and the changes in liver lipid metabolism are due to an alteration in adenosine triphosphate (ATP) metabolism in mitochondria. In order to test the possibility that oxidative phosphorylation is impaired by the parenteral administration of lanthanide metal ions prior to manifestation of fatty infiltration of the liver, the metabolism of rat-liver mitochondria was studied 6 hr after the intravenous injection of $LaCl_3$ or $Pr(NO_3)_3$. However, the P/O ratios of the liver mitochondria isolated after such pretreatment were found to be normal. The effects of the rare earth ions on non-enzymic hydrolysis of ATP at pH 7.3 to 7.5 were also tested. The data show that the trivalent ions of the rare earths tested do not stimulate the enzymic splitting of ATP by mitochondrial digitonin fragments. The data presented then do not support the view that the ions of La, Pr, Nd, and Sm have a direct toxic effect on the synthesis or breakdown of ATP in mitochondria. (P.C.H.)

13929 THE METABOLISM OF LIVER AND SPLEEN NUCLEIC ACIDS OF LETHALLY IRRADIATED RATS TREATED WITH HOMOLOGOUS DEOXYRIBONUCLEIC ACID ISOLATED FROM NONIRRADIATED RATS. A. Bećarević, V. Janković, S. Petrović, D. Kanazir, and G. Jovicki. Bull Inst. Nucl. Sci. "Boris Kidrich" (Belgrade), 13: No. 4, 35-41(Dec. 1962).

A study was made on the incorporation of sodium formate-C^{14} into the liver and spleen RNA of lethally irradiated rats treated with a homologous native liver DNA from non-irradiated rats. The results indicate that the injected homologous native liver DNA affects the metabolic activity of the liver and spleen RNA of lethally irradiated ($LD_{100/30}$) rats on the fourth day after the irradiation and treatment. (P.C.H.)

13930 PROBLEMS OF ENERGY TRANSFER IN PHOTODYNAMIC REACTIONS. Leonida Santamaria (Univ. of Milan). Bull. Soc. Chim. Belges, 71: 889-705(Nov.-Dec. 1962). (In English)

Data are reported which permit one to explain the photodynamic phenomenon as an energy transfer of importance in biology and medicine as well as of interest in physical chemistry. A study carried out with the help of ESR is considered; the experimental conditions influencing signal production appear to be the same as those determining the effect observed with other methods in the same photodynamic system. A scheme is proposed, where the sensitizer is excited to a triplet state, which combines with oxygen to form an "oxyradical"; the latter reacts then with the substrate. The importance of the interaction between sensitizer and substrate, possibly by London-Van der Waals forces, is discussed as a condition for the photodynamic reaction. Complex formation between sensitizer and substrate is also taken into consideration. (auth)

13931 FUNCTIONAL IMPLICATIONS OF INTERACTIONS OF EXTRACELLULAR IONS WITH LIGANDS OF THE CELL MEMBRANE. Aser Rothstein (Univ. of Rochester, N. Y.). Circulation, 26: 1189-1200(Nov. 1962).

Discussion is given on three examples in which interactions of chemical agents with ligands of the plasma membrane were chemically characterized and the resulting disturbance in membrane function was quantitatively meas-

ured. Uranyl ion reacts with phosphoryl groups and specifically blocks the transfer of glucose across the membrane. Cationic redox dyes and mercuric chloride react with sulfhydryl groups and destroy the structural integrity of the membrane. Arsenate competes with phosphate for a specific active-transport system and blocks the system by irreversibly combining with one of its components. (auth)

13932 PLASMA CATECHOL AMINE LEVELS AND ADRENAL ASCORBIC ACID CONTENT FOLLOWING β-MERCAPTOETHYLAMINE (MEA) ADMINISTRATION. M. H. Heiffer, R. L. Mundy, and B. Mehlman (Walter Reed Army Medical Center, Washington, D. C.). Endocrinology, 69: 746-51(Oct. 1961).

The effects of MEA on the peripheral plasma catechol amine level and adrenal ascorbic acid content of rats were determined at 10, 30, and 60 min following intraperitoneal injections of 125 mg/kg MEA. An increase of plasma epinephrine concentration occurred 10 minutes after administration of MEA and the elevation persisted throughout the 1-hr observation period. Similar results were obtained after administration of cystamine. Injection of 125 mg/kg MEA to intact rats also caused a significant decrease in adrenal ascorbic acid content at the end of 1 hr as compared with saline control rats. However, MEA had no effect on the concentration of adrenal ascorbic acid of hypophysectomized rats. The results indicate that the decrease of adrenal ascorbic acid of intact rats following MEA treatment is not due to its direct action on the adrenal gland. It is suggested rather that the depletion is due to stimulation of ACTH secretion from the anterior pituitary, which may be brought about by release of epinephrine, probably acting through the hypothalamus. (H.H.D.)

13933 SOME EFFECTS OF PARATHYROID HORMONE ON THE METABOLISM OF Sr^{85} AND Ca^{45} BY EMBRYONIC CHICK BONE CULTURED IN VITRO. F. W. Lengemann (Cornell Univ., Ithaca, N. Y.). Endocrinology, 72: 364-9 (Mar. 1963).

Embryonic chick bone was cultured in vitro in a synthetic medium (N.C.T.C.-109) to test the effect of parathyroid extract (PTE) on the metabolism of Ca^{45} and Sr^{85}. When contrasted with the control bones, PTE at levels of 0.01, 0.1, 1, and 10 units/ml of medium led to less accumulation of Sr^{85} and Ca^{45} in the bone and increased Observed Ratio (bone/medium). The low levels of PTE increased, while the very high levels of PTE decreased, both the growth and mass of the bones. The short term uptake of Sr^{85} and Ca^{45} was unaffected by pretreatment of the bone with PTE except at a level of 10 units/ml. PTE at 0.1 and 1.0 unit/ml did not change the proportion of labile to nonlabile Sr^{85} and Ca^{45} in the bones. The nonlabile fraction could be readily mobilized by the addition of PTE into the medium, with 0.1 and 1.0 unit/ml having an apparently equal effect. Sustained PTE treatment of the bones increased the mobility of the nonlabile fraction over that observed after a relatively short exposure to the hormone. PTE acted to reduce the isotope content of growing bone by increasing the movement of mineral from bone to medium, and thus reduced the size of the mineral compartment. (auth)

13934 THE EFFECT OF RADIATIONS AND RADIOPROTECTIVE AND RADIOSENSITIZING DRUGS ON FAT METABOLISM. P. Paoletti and E. Grossi (Università, Milan). Giorn. Ital. Chemioterapia, 6-9: 225-9(July-Sept. 1962). (In Italian)

Studies were made on the action of a radioprotective substance, cysteamine, and a radiosensitizing substance, Synkayvite, on radiation effects on the hepatic and cerebral synthesis of fats. Pretreatment with cysteamine was found to protect animals both from an increase in hepatic fat synthesis and from a fall in cerebral fat synthesis, which result from irradiation. Cysteamine by itself did not give rise to changes in the degree of fat synthesis either in the liver or in the brain. Pretreatment with Synkayvite potentiates the effect of radiations on fat synthesis in the liver, where this is further increased and in the brain where it is further depressed. Synkayvite was found to exert a moderate action of a radiomimetic type on fat synthesis in the liver by itself. (auth)

13935 VARIABILITY OF RELATIVE ORGAN CONCENTRATION OF TRACE ELEMENTS IN HUMAN TISSUE. W. S. Snyder and M. J. Cook (Oak Ridge National Lab., Tenn.). Health Phys., 9: 57-62(Jan. 1963).

The extent of individual variation of the concentration of certain elements in human tissue was studied. The data were obtained from emission spectrographic studies of human tissue. There is strong evidence that within a homogeneous population group the fraction of the population exceeding the sample mean by a factor of three will not exceed 5 per cent of the population. This was true in nearly all cases where the sample size was sufficiently large to permit the estimation of 5 per cent of the population at the 95 per cent confidence level. Elements studied include Cd, Cu, Zn, and Al in the kidney, liver, and lung. These tests indicate that for such elements and under continuous exposure to radionuclides in the environment, only a small fraction of a homogeneous population group will receive a dose in excess of three times the mean dose for the group. This tends to validate the assumption of the Federal Radiation Council in its Report No. 1 concerning the distribution of the dose in such a group. (auth)

13936 SOME OBSERVATIONS CONCERNING URANIUM CONTENT OF INGESTA AND EXCRETA OF CATTLE. T. S. Chapman and S. Hammons, Jr. (Dow Chemical Co., Denver). Health Phys., 9: 79-81(Jan. 1963).

The normal diet of a herd of dairy cattle in Larimer County, Colorado, contains 5,000 μμc of uranium per head per day. Most of this is in the feed concentrate. Only 0.6 per cent of the fecal excretion is observed in the urine and milk combined. (auth)

13937 POTASSIUM METABOLISM AND THE ACCUMULATION OF CESIUM-137 BY DECAPOD CRUSTACEA. G. W. Bryan (Plymouth Lab., Eng.) and Eileen Ward. J. Marine Biol. Assoc. U. K., 42: 199-241(1962).

A comparative study was made of the accumulation and loss of Cs^{137} in relation to K metabolism in the lobster Homarus vulgaris, common prawn Palaemon serratus, and freshwater crayfish Astacus (Austropotamobius pallipes pallipes). In unfed crustacea Cs^{137} is taken up and lost far more slowly than K^{42}. Although all the inactive K in the crustacea can be exchanged with K^{42}, higher whole-animal concentration factors are reached for Cs^{137} (about 8 for lobsters and 25 for prawns). In crayfish in 0.1% sea water, Cs^{137} is not concentrated to the same extent as K by whole animals (50-200 for Cs^{137} against about 4500 for K). Crayfish selectively excrete Cs^{137} in the urine relative to K at a lower concentration than in the plasma. In the accumulation of Cs^{137} by all species, muscle is the principal limiting factor, but with K^{42} the body surface becomes more limiting. Experiments on the absorption of Cs^{137} from food in prawns and freshwater crayfish were also carried out. The excretory organs are important in the metabolism of Cs^{137} in lobsters and prawns; at equilibrium they account for about 30% of Cs^{137} outflux. On the other hand, they account for only about 1% of K^{42} outflux. In the crayfish, the excretory

organs appear to be possibly more important in K metabolism. Generally, Cs^{137} behaves similarly to K. More important differences are the accumulation of Cs^{137} by prawn blood while K is excluded and the apparent secretion of the isotope into the urine of lobsters and to some extent prawns. (P.C.H.)

13938 ABSORPTION OF Ca^{45} AND Sr^{85} FROM SOLID AND LIQUID FOOD AT VARIOUS LEVELS OF THE ALIMENTARY TRACT OF THE RAT. C. S. Marcus and F. W. Lengemann (Cornell Univ., Ithaca, N. Y.). J. Nutr., 77: 155-60(June 1962).

The total absorption of Ca^{45} and Sr^{85} by the rat small intestine from a liquid dose of food averaged 45 and 28%, respectively; from solid dose it averaged 19 and 13%. The differences were highly significant. Solid food left the stomach more slowly than liquid, but the time necessary for food to start entering the cecum was the same for both. Absorption of Ca^{45} and Sr^{85} occurred rapidly at first, but then tapered off and essentially ceased after about 2 hr for the liquid dose and 6 hr for the solid dose. The ratio of absorbed Sr^{85}/Ca^{45} per rat, averaged over time intervals of 15 min to 12 hr, was 0.67 ± 0.020 for rats given labeled solid food. The ratio was independent of time or food consistency. The total relative per cent of Sr^{85} and Ca^{45} absorbed in each of the gut components was estimated after absorption had ceased. For liquid dose the values were: stomach 0, duodenum 15, jejunum 23, and ileum 62%. For the solid dose the corresponding values were 0, 8, 4, and 88%, respectively. The relative per cent absorption of Ca^{45} and Sr^{85} was the same throughout the alimentary tract. It was postulated that an absorption mechanism exists throughout the entire small intestine, which is more efficient for Ca than for Sr but which handles both. (P.C.H.)

13939 ON THE CAUSE OF VITAMIN K DEFICIENCY IN MALE RATS FED IRRADIATED BEEF AND THE PRODUCTION OF VITAMIN K DEFICIENCY USING AN AMINO ACID SYNTHETIC DIET. M. S. Mameesh, V. C. Metta, P. B. Rama Rao, and B. Connor Johnson (Univ. of Illinois, Urbana). J. Nutr., 77: 165-70(June 1962).

Vitamin K deficiency, as seen by a hemorrhagic syndrome, developed in rats fed a diet consisting entirely of ground beef irradiated at 2.79 or 5.58 Mrad. Addition of soybean protein and corn oil to the diet prevented the deficiency. Or, addition of 0.1 μg vitamin K_1/g of dry irradiated beef diet maintained normal plasma prothrombin levels. There was no evidence that irradiation caused the formation of vitamin K antagonists in ground beef. If coprophagy is prevented, deficiency develops more rapidly in rats on the irradiated beef diet. Assay of the vitamin K activity in the diet indicated that after irradiation of ground beef its menadione-equivalent vitamin K activity falls to 14 to 16 μg/100 g dry wt compared with 35 in nonirradiated beef. It was estimated that the irradiated beef contains ~ one-half of the vitamin K required to maintain a normal prothrombin level. Fecal synthesis of vitamin K was not diminished by feeding the irradiated beef. (H.H.D.)

13940 CHANGES IN CALCIUM–Sr^{90} DISCRIMINATION WITH AGE IN YOUNG MINIATURE SWINE. R. O. McClellan, J. R. McKenney, and L. K. Bustad (General Electric Co., Richland, Wash.). Life Sci., No. 12: 669-75(1962). (HW-SA-2790)

Miniature female pigs nine months of age were placed on daily Sr^{90} feeding at levels of 1, 5, or 25 μc per day. The females were bred and immediately after birth a number of offspring were killed. The majority of the offspring, however, were allowed to remain with their dams until weaning at six weeks of age, at which time additional animals were killed. When females of the F_1 generation reached nine months of age, they were bred and gave birth to an F_2 generation. Values for 3-month-old animals were essentially the same as those for 6-month-old animals. At 3 and 6 months, no difference was observed between values of F_1 and F_2 generations. The data indicate a lessened discrimination against Sr^{90} relative to calcium in the young. The ratio of Sr^{90}/Ca^{45} for the diet observed at weaning was greater than 0.5, while after 63 days of feeding, it was less than 0.3. Data are tabulated. (P.C.H.)

13941 MODEL FOR THE ACCUMULATION OF STRONTIUM AND CALCIUM BY RECENTLY MOLTED CRAYFISH (CAMBARUS LONGULUS LONGEROSTRIS ORT.). J. M. Schurr and M. N. Stamper (Oak Ridge National Lab., Tenn.). Limnol. Oceanog., 7: 474-7(Oct. 1962).

After molting, crayfish absorbed Sr^{85} rapidly; rates of uptake decreased exponentially as an upper limit was approached (T 1/2 = 1 to 2 days). A simple mathematical model attributes this limit to the number of sites available for deposition in the exoskeleton. Deposited ions are relatively immobile until 2 to 4 days prior to the next molt, when some are redistributed to the calcareous gastroliths prior to reuse. (auth)

13942 RETENTION IN THE SKELETON OF RADIOSTRONTIUM AS INFLUENCED BY TETRACYCLINE. A. Catsch (Kernforschungszentrum, Karlsruhe, Ger.). Nature, 197: 302(Jan. 19, 1963).

Experiments indicate that neither post-treatment nor simultaneous administration of tetracycline aids in the reduction of skeletal retention of strontium-85. A significantly reduced deposition was achieved by tetracycline when given prior to injection of strontium-85. Due to the pronounced affinity of tetracycline to bone tissue, it is believed that this reaction leads to the impairment of the mechanisms responsible for the retention of radiostrontium by bone. (H.G.G.)

13943 GROSS STRUCTURE OF HAEMOGLOBIN A_3 AND THE NATURE OF ITS BINDING TO CHROMIUM-51. H. A. Pearson, M. T. Van Metre, and K. M. Vertrees (National Naval Medical Center, Bethesda, Md.). Nature, 197: 472-3 (Feb. 2, 1963).

The nature of the binding of Cr^{51} by the three fractions of hemoglobin was investigated. Starch block electrophoresis was used for the separation of hemoglobin fractions. The relation of radioactivity to protein fractions was determined in hemoglobin labeled with Cr^{51}. It was concluded that the increased activity of Cr^{51} observed in the hemoglobin A_3 fraction after electrophoresis at alkaline pH is not due to a polypeptide configuration but to anodal migration of hemoglobin molecules tagged with Cr^{51}. (C.H.)

13944 ACCUMULATION OF RADIUM-226 BY THE FRESHWATER GASTROPOD LYMNAEA STAGNALIS L. O. Van der Borght (Centre d'Etude de l'Energie Nucléaire, Mol, Belg.). Nature, 197: 612-13(Feb. 9, 1963).

Exposure of the fresh-water snail Lymnaea stagnalis to solutions containing Ra^{226} revealed the accumulation of Ra in the shell. The concentration of Ra indicates an active transport mechanism for Ra^{226}. (C.H.)

13945 INCORPORATION OF IRON-59 INTO THE CELLS OF DIFFERENT TISSUES OF CHIRONOMUS PLUMOSUS. M. Oektay and A. Senguen (Univ. of Istanbul). Nature, 197: 613-14(Feb. 9, 1963).

The incorporation of Fe^{59} into cells and tissues of the larval form of the insect Chironomus plumosus was studied. No differences were observed resulting from the concentration of $Fe^{59}Cl$ and immersion period in aqueous solutions. (C.H.)

13946 BINDING OF STRONTIUM IN BLOOD. T. E. F. Carr, G. E. Harrison, J. F. Loutit, and Alice Sutton (Medical Research Council, Harwell, Berks, Eng.). Nature, 197: 710(Feb. 16, 1963).

The relative specific activities of Sr in urine and plasma were measured following the ingestion of radioactive Sr by normal subjects. It was concluded that the specific activities of Sr in plasma and urine are equal. (C.H.)

13947 SEX DIFFERENCES IN THE PATTERN OF RADIOIODINE EXCRETION IN THE URINE OF INTACT STILBOESTROL-TREATED GUINEA PIGS. A. Ślebodziński (Inst. of Animal Husbandry, Krakow). Nature, 197: 801-2 (Feb. 23, 1963).

Studies on the effect of stilbestrol on the excretion of I^{131} in guinea pigs showed that the female is more stimulated by large doses of stilbestrol and returns more quickly to the normal condition than does the male. Female guinea pigs were not affected as much by small doses of stilbestrol as were males. (C.H.)

13948 ALKALINE EARTHS IN HEPARIN. G. E. Harrison and Alice Sutton (Medical Research Council, Harwell, Berks, Eng.). Nature, 197: 809(Feb. 23, 1963).

Five different preparations of heparin were found to contain varying amounts of Ca, Sr, and Ba. The importance of analyzing each preparation of heparin used as an anticoagulant for the estimation of alkaline earths in plasma is discussed. (C.H.)

13949 UV IRRADIATION OF DESOXYRIBONUCLEIC ACIDS OF DIFFERENT BASE COMPOSITION IN AQUEOUS SOLUTION. H. Venner, CH. Zimmer, and R. Horn (Akademie der Wissenschaften, Berlin). Naturwissenschaften, 49: 542(1962). (In German)

The dependence of the helix-coil transition on the irradiation time was investigated on desoxyribonucleic acids of varying composition and heterogeneity. The fall of the T_m value with increasing irradiation time is shown graphically. In heterogeneous DNA types (calf thymus and herring sperm) and in DNA with high GC concentration (Streptomyces chrysomallus), significant anomalies were observed in the T_m decrease. The heterogeneity of the DNA increases after irradiation, corresponding to a broadening of the thermal transition. (J.S.R.)

13950 THE DETERMINATION OF THE NATURALLY OCCURRING ALPHA-EMITTING NUCLIDES IN HUMAN BONES. R. Rajewsky and W. Stahlohofen (Max-Planck-Institut für Biophysik, Frankfurt am Main). Naturwissenschaften, 49: 607(1962). (In German)

A mixed method, in which the material to be measured is mixed with ZnS(Ag) in a fixed ratio, is described, and the procedure to be used for reproducible results is given. The amount of Ra^{226} and Th^{228} and the Th^{228}/Ra^{226} in ashed and fresh human bone was determined, and the results are given in tabular form. The mean Ra^{226} content per gram bone ash was $1.4 \pm 0.5 \times 10^{-14}$ c, and the mean Th^{228} per gram bone ash, $5 \pm 1 \times 10^{-15}$ c. These results agree within the measurement accuracy with the results obtained with the chemical precipitation method. (J.S.R.)

13951 STUDIES IN THE METABOLISM OF CARRIER-FREE RADIO-RUTHENIUM. THE PREPARATION AND METABOLISM OF NITROSYL-RUTHENIUM NITRO COMPLEXES. R. S. Bruce and S. Jackson (Medical Research Council Radiobiological Research Unit, Harwell, Berks, Eng.). Phys. Med. Biol., 7: 463-71(Feb. 1963).

Nitro complexes of nitrosyl ruthenium were produced by treating a solution of the nitrosyl trinitrate of carrier-free Ru^{106} with oxides of nitrogen. Nitrate complexes were removed by co-precipitation with ferric hydroxide, and the supernatant solution, enriched in nitro complexes, was administered to rats by stomach tube. Rats were sacrificed serially for analysis of the tissues, and the Ru content of the excreta was also determined. About 4% of the administered Ru was absorbed, and one-fifth was still retained after 28 days. Ru was distributed generally throughout the body without any large difference in concentration between the tissues, except that a higher concentration was found in the kidneys. Very little Ru was found in the wall of the small intestine. (P.C.H.)

13952 PRIMARY QUANTUM CONVERSION IN PHOTOSYNTHESIS. Melvin Calvin and G. M. Androes (Univ. of California, Berkeley). Science, 138: 867-73(Nov. 23, 1962). (UCRL-10423)

The utilization of energy in the photosynthetic process is discussed. The primary quantum conversion act is defined, and it is shown that this act involves the production and separation of a primary transient oxidant and reductant. Electron spin resonance spectra, the effects of temperature on the spectra, and optical density changes in photosynthetic tissue are reported. The experimental results indicate that the primary act involves hole and electron migration. (D.L.C.)

13953 EFFECT OF γ-IRRADIATION ON AMOUNT OF ASCORBIC ACID IN ORGANS OF RATS. Kh. F. Bass-Shadkhan. Tr. Inst. Eksperim. i Klinich. Med., Akad. Nauk Latv. SSR, No. 28, 129-34(1962).

Three groups of rats on different diets were subjected to 700 r γ irradiation. Group I received a fully adequate diet; group II, a deficient diet; and group III, a deficient diet supplemented with a protein-vitamin complex containing all the nutritional elements needed for normal metabolic processes. The amount of ascorbic acid in the small intestine decreased 36 hr after γ irradiation (45%) in groups I and III, after which it started to increase, exceeding that of the controls 5 days after irradiation and remaining higher than the original level throughout the 50-day experiment. The amount of ascorbic acid in the small intestine of group II rats increased after irradiation and remained higher than that of the controls throughout the experiment. In all three groups the amount of ascorbic acid in the liver increased during the first 5 days after irradiation, then decreased to the level of the controls (10 days after irradiation), and increased again slightly, exceeding the level of the controls. However, the data are not statistically reliable. The amount of ascorbic acid in the suprarenal glands of the rats of all three groups was only slightly affected by γ irradiation. (OTS)

13954 PROBLEMA VYVEDENIYA IZ ORGANIZMA DOLGOZHIVUSHCHIKH RADIOAKTIVNYKH IZOTOPOV. (Extraction of Long-life Radioisotopes from Organisms). V. S. Balabukh, L. M. Razbitnaya, N. O. Razumovskii, and L. I. Tikhonova. Moscow, Gosatomizdat, 1962. 168p.

Chemical extraction of radioisotopes from animal organisms was studied, and applications of complexing agents as prophylactic and therapeutic measures are analyzed. A table is given of the stability constants for more important complexes. Extensive references for each chapter are included. (R.V.J.)

13955 BONE-SEEKING RADIONUCLIDES IN MINIATURE SWINE. R. O. McClellan, L. K. Bustad, W. J. Clarke, N. L. Dockum, J. R. McKenney, and H. A. Kornberg (General Electric Co., Richland, Wash.). p.341-8 of "Some Aspects of Internal Irradiation." [New York], Pergamon Press, 1962.

Miniature swine were fed four levels of Sr^{90}—1, 5, 25, and 125 μC/day. Animals maintained on 25 μC of Sr^{90} per day for over two years appear normal and their 18-month-old offspring exposed to Sr^{90} since conception have manifested only a slightly depressed growth rate. Adult animals fed 125 μC of Sr^{90} per day for eight months, together with their three-month-old offspring, appear clinically normal. (P.C.H.)

13956 SKELETAL SELF-ABSORPTION OF BETA-PARTICLE ENERGY. W. W. Parmley, J. B. Jensen, and C. W. Mays (Univ. of Utah, Salt Lake City). p.437-53 of "Some Aspects of Internal Irradiation." [New York], Pergamon Press, 1962.

Calculated self-absorptions of beta energy in the skeleton were experimentally confirmed for $Sr^{90} + Y^{90}$. Skeletal absorption decreased with increasing beta-particle energy and increased with bone size. A mammalian skeleton of (W) g wet weight is roughly equivalent in beta absorption to a cylinder 1.42 g/cc in density and 0.086 cm $\sqrt[3]{W}$ in diameter. Beta energy escaping from the skeleton may cause damage to the soft tissue in which it is absorbed. Although two beta emitters may be deposited similarly, differences in their energy absorption ratios may change the ratio of the localized response. (P.C.H.)

Fallout and Ecology

13957 THE NATURAL Pb^{210} AND Po^{210} CONTENT IN THE BONES OF HUMANS. E. Groos, E. L. Sattler, and W. Stahlhofen (Max-Planck-Institut für Biophysik, Frankfurt am Main). Atomkernenergie, 8: 32-3(Jan. 1963). (In German)

A determination of the Pb^{210} and Po^{210} contents of human bones was necessary in order to obtain information on body radioactivity. The average value of the Pb^{210} activity per gram of bone ash was 1.1×10^{-13} C; the activity per gram of fresh weight was 3.2×10^{-14} C. For Po^{210} these values were 1.3×10^{-13} and 3.1×10^{-14} C, respectively. This agreed with previous results that the ratio Pb^{210}/Po^{210} is about 1 for the human organism. (M.C.G.)

13958 Sr^{90}: INVESTIGATION IN SOME FOOD MATERIALS IN THE PROVINCE OF PALERMO. C. Cappadona and G. Fierotti (Università, Palermo, Italy). Minerva Nucl., 6: 316-18(Oct. 1962). (In Italian)

The concentration of Sr^{90} was measured in samples of soil, milk, cheese, vegetables, cereals, fodder, and drinking and natural waters, collected in the months of November and December 1961 in the Province of Palermo. No increase attributable to the Soviet nuclear tests held in autumn 1961 were found. Future experiments will show whether or not the Soviet and American nuclear tests have raised the level of Sr^{90}. (auth)

13959 INCREASE OF STRONTIUM-90 AND CAESIUM-137 IN JAPANESE LEAFY VEGETABLES DUE TO THE RUSSIAN NUCLEAR TESTS, 1961. Ryushi Ichikawa and Masako Eto (National Inst. of Radiological Sciences, Chiba City, Japan). Nature, 197: 509-10(Feb. 2, 1963).

Data are presented on the content of Sr^{90} and Cs^{137} in leafy vegetables in Japan during the period from May 1961 to March 1962. A marked increase was noted in samples collected in 1962. This was attributed to contamination from fallout from Russian nuclear tests during Sept. and Oct. of 1961. (C.H.)

13960 FALLOUT AND FARM ANIMALS. R. J. Garner (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). Nutrition Abstr. Rev., 32: 4863(July 1962).

From consideration of published results, it was concluded that a cow would have to ingest from 300 to 25000 times as much I^{131} to cause economic damage as would give the maximum permissible level of the nuclide, 130 μμC per liter, in milk. Similarly for Sr^{90} and Cs^{137} there seems to be no danger to grazing stock as long as no risk to the human population is present. (Public Health Eng. Abstr., 42: No. 12, 1962).

Radiation Effects on Living Tissues

Refer also to abstracts 14588 and 14589.

13961 (AD-277946) SURVEY OF NATURAL FOOD SUBSTANCES WHICH MODIFY RESPONSE TO RADIATION. Final Report, January 15, 1960–August 31, 1961. Gordon W. Newell, W. A. Skinner, and Phyllis A. Havens (Stanford Research Inst., Menlo Park, Calif.). Jan. 12, 1962. Contract DA19-129-qm-1547. 23p.

Whole-body gamma-radiation doses of 350 to 390 r resulted in 87 to 94% mortality within 30 days for guinea pigs fed a bran-oat, corn oil, vitamin A, and vitamin C diet. Supplements of dehydrated alfalfa and fresh broccoli, either alone or in combination, reduced mortality to a range of 20 to 45%. The following supplements provided borderline to marked radioprotective activity: a complete vitamin mixture, beta-carotene, a water extract of dehydrated alfalfa, an alcohol-soluble fraction of the water extract, and a neutral-components fraction of the water extract. Food substances that gave no radiation protection included: a synthetic basic mineral mixture, casein, alfalfa ash, vitamin E, vitamin A, hesperidin, and coumestrol. (auth)

13962 (ASD-TR-16-510) SKIN TEMPERATURE RESPONSES TO SIMULATED THERMONUCLEAR FLASH. William C. Kaufman, A. G. Swan, and H. T. Davis (Wright Air Development Center, Aerospace Medical Lab., Wright-Patterson AFB, Ohio). Sept. 1961. 13p. (AD-273095)

Skin temperatures and radiant energy were measured on a subject wearing flight clothing, sitting in a tactical aircraft exposed to thermal energy characteristic of thermonuclear weapons. Radiant energy source was 960 lamps at power levels up to 4000 kilowatts. After exposures of increasing severity, subject tolerance was attained in a 3 cal/cm^2 pulse of 3.7 seconds duration. This pulse charred paint on the fuselage and headrest and seared the subject's glove. Bare forehead skin temperature reached 126°F resulting in distinct pain. The data provide a basis for calculating the nearest safe distance of aircrew members to a nuclear explosion. (auth)

13963 (BNL-6186) PATHOLOGIC AND BEHAVIORAL CHANGES IN MICE FOLLOWING CNS DEUTERON IRRADIATION. J. M. Ordy, H. W. Barnes, T. Samorajski, H. J. Curtis, L. Wolin, and W. Zeman (Cleveland Psychiatric Inst. and Hospital, Cleveland; Brookhaven National Lab., Upton, N. Y.; and Indiana Univ., Indianapolis. Medical Center). [1962]. Contract [AT-30-2-GEN-16]. 23p.

Radiogenic lesions were produced in mice by 1 mm focal deuteron beams at a dose of 8,000 rads directed unilaterally and bilaterally to the parietal areas and unilaterally to the cerebellum, and by two 9 × 0.025 mm microbeams, 0.5 mm apart, applied across the neocerebellar cortex at 72,000 rads. These histopathologically demonstrable alterations were related to possible behavioral changes following irradiation. Tissue sections from appropriate cortical areas were examined histologically from 23 subjects at

varying intervals ranging from 36 hours to 30 days following irradiation. Histopathologic examinations revealed almost complete destruction of all tissue components along the microbeam paths within 2 days following irradiation. A 1 mm beam at 8,000 rads produced necrosis confined to the deep regions of the irradiated area involving both cellular and vascular components within 8 days of irradiation. Fifty mice, including ten sham irradiated behavioral controls were tested before and following deuteron irradiation on the open field test based upon exploratory behavior, spontaneous locomotor activity in activity wheels, and stress reactivity under shock motivated escape-avoidance conditions. A statistical evaluation of the behavioral findings indicated no major changes in behavior attributable to the radiogenic lesions during a 35 day postirradiation period. However, four months following irradiation, significant differences appeared among the groups on locomotor activity wheel performance. A long-term follow-up study is in progress with all 5 groups of the present experiment. Additional biochemical, physiological, and behavioral tests will be carried out to determine the long-term effects following high-dose focal deuteron irradiation. (auth)

13964 (BNL-6202) THE ULTRAVIOLET SENSITIVITY OF FROZEN PHAGE. Myron Levine and Emma Cox (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract [AT-30-2-GEN-16]. 20p.

Phage P22 of Salmonella typhimurium is much more sensitive to 2537 Å ultraviolet light when irradiated in frozen (–80°C) aqueous suspension than when irradiated at room temperature in the liquid phase. That this hypersensitivity is an effect on the DNA of the phage rather than on phage protein is strongly suggested by the failure to find increased sensitivity when frozen phage is irradiated with 2894 Å light. Hypersensitivity to germicidal light is not found with phage irradiated in frozen glycerol. It is suggested that the crystalline state of water is a requisite for the effect of germicidal light on frozen phage. (auth)

13965 (BNL-6704) RADIATION-INDUCED MAMMARY GLAND NEOPLASIA IN THE RAT. V. P. Bond, E. P. Cronkite, C. A. Shellabarger, and G. Aponte (Brookhaven National Lab., Upton, N. Y.). 1962. Contract [AT(30-2)-Gen-16]. 26p.

Reaction mechanisms involved in the induction of mammary gland neoplasia in rats by exposure to ionizing radiation are discussed. Doses of 400 r total-body Co^{60} γ radiation resulted within 10 to 12 mo in mammary gland neoplasia in a large percentage of exposed rats. Many of the animals developed tumors in more than one mammary gland, and as many as 10 neoplasms were observed in a single animal. The neoplasms were generally of 4 types. The effects of hormones, dose, partial-body shielding, fractionated dosage, and the possible virus etiology of neoplasms are discussed. Data indicate that a two-stage, or more, mechanism is involved and that radiation acts as the initiating factor and the ovarian hormones act as a promoting substance. The radiation data are consistent with the no-threshold, proportionality hypothesis of radioinduced neoplasia. (C.H.)

13966 (HW-SA-2588) REACTIVITIES OF ORGANIZED BIOCHEMICAL SYSTEMS WITH RADIATION-PRODUCED RADICALS. Donald R. Kalkwarf (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [May 15, 1962]. Contract AT(45-1)-1350. 9p.

An investigation was made of the reactivities of biochemical systems in dilute aqueous solutions with radioinduced free radicals. Erioglaucine was used as the reference compound. Data are presented on the relative rate constants for reactions of amino acids and dipeptides with radicals produced in irradiated water, a comparison of estimated and experimentally determined relative rate constants, the relative rate constants for reactions of sugars and polysaccharides with radicals produced in irradiated water, the relative rate constants for reactions of agarose with radicals produced in irradiated water, and the protection against radioinduced hemolysis of red blood cells afforded by valine, histidine, tryptophan, or erioglaucine. The effects of rate constants for two competing biomolecular reactions, the additivity of values, and the effect of protein structure on free radical attack on results are discussed. (C.H.)

13967 (NP-12484) QUARTERLY PROGRESS REPORT NO. 46 [ON RADIOBIOLOGY]. (Chicago. Univ. Air Force Radiation Lab.). Jan. 15, 1963. Contract AT 41(609)-6693. 161p.

Progress in radiation biology is reported. Topics covered include: the effects of ionizing radiations on the biochemistry of mammalian tissues, the influence of exposure to low levels of gamma or fast neutron irradiation on the life span of animals, and pharmacological and toxicological compounds as protective or therapeutic agents against radiation injury in experimental animals. Separate abstracts were prepared for each of eleven papers on these topics. (M.C.G.)

13968 (NP-12484(p.1-14)) THE INFLUENCE OF X-IRRADIATION ON THE REDUCTASE ACTIVITY OF THE LIVERS OF RATS. Kenneth P. DuBois and Bernard E. Hietbrink (Chicago. Univ. Air Force Radiation Lab.).

A study was made of the influence of x radiation on the reductase activity of mammalian tissues. The enzymatic reduction of p-nitrobenzoic acid to p-aminobenzoic acid was used as a measure of reductase activity. The method was applied to the tissues of rats and mice. No sex nor species differences were observed. Results indicated that the enzyme activity is less than half the adult level at 22 days of age and it increases to the adult level by 35 days of age. Exposure of 23-day old rats to 400 r of whole-body x-irradiation had no effect on the rate of development of the reductase activity of the livers in contrast to the marked inhibitory effect of this dose of radiation on the development of other microsome enzymes in the liver. (M.C.G.)

13969 (NP-12484(p.15-25)) INFLUENCE OF X-IRRADIATION AND A NITROGEN MUSTARD ON THE DEVELOPMENT OF A THIOPHOSPHATE-OXIDIZING ENZYME SYSTEM IN THE LIVERS OF YOUNG MALE RATS. Bernard E. Hietbrink, Marjorie Keshmiri, and Kenneth P. DuBois (Chicago. Univ. Air Force Radiation Lab.).

Additional studies were undertaken to determine the radiosensitivity of the drug metabolizing enzyme system in the livers of young male rats. The results of experiments on the influence of partial body shielding indicated that the administration of 600 r of x radiation to the liver area of 23-day old rats appeared to stimulate the synthesis of the phosphorothioate-oxidizing enzymes for a period of about 10 days after exposure but caused a substantial inhibition in the rate of synthesis during the third week following irradiation. The injection of 200 mg/kg of 2-mercaptoethylamine (MEA) 10 min before and x-ray dose of 400 r provided a substantial reduction in the radioinduced inhibition of the development of the drug metabolizing enzyme system in the livers of young male rats. Measurements of the effect of MEA on the radioinduced inhibition of the development of resistance to 0,0-diethyl 0-(4-

methylthio-m-tolyl) phosphorothioate (DMP) were performed. Tests showed that 50 mg, an ordinarily sublethal dose, caused 100% mortality of rats given 200 or 400 r while 44 and 15% of the animals treated with MEA before 200 and 400 r, respectively, survived. (auth)

13970 (NP-12484(p.26-34)) THE INFLUENCE OF VARIOUS CHEMICAL COMPOUNDS ON RADIATION-INDUCED CHANGES IN ENZYME ACTIVITIES IN CERTAIN RAT TISSUES. Bernard E. Hietbrink and Marjorie Keshmiri (Chicago. Univ. Air Force Radiation Lab.).

A study was conducted to determine the influence of sodium pentobarbital on the radioprotective activity of dimethylammonium dimethyldithiocarbamate (DMDTC) and sodium diethyldithiocarbamate (DEDTC) in the spleens, thymus glands, and small intestines of rats. Administration of 25 mg/kg of sodium pentobarbital five minutes before or after DMDTC or DEDTC markedly reduced the radioprotective activity of these derivatives of dithiocarbamic acid. The influence of selachyl acetate and batyl acetate on the changes in the enzyme activities of the spleen, thymus glands, and intestine of the rat was investigated. It was found that the injection of 10 mg/kg or 50 mg/kg of selachyl acetate five minutes before or immediately after a dose of 400 r of x rays provided substantial reductions in the biological effect of 400 r in the spleen but did not significantly benefit the thymus glands and small intestine. Administration of 30 mg/kg of batyl acetate five minutes before 400 r of x rays also provided substantial protection in the spleen but only slight reduction in the biological effect of radiation in the spleen was observed when batyl acetate was given immediately after 400 r. Results of preliminary studies indicated that administration of 125 mg/kg of 2-imino-thiazolidine-4-carboxylic acid (expressed as equivalents of HCN) 25 minutes before or 25 minutes after x irradiation provided 37 and 33% reductions, respectively, in the biological effects of 400 r in the spleen. This treatment failed to reduce the injurious effects of x rays in the small intestine. (auth)

13971 (NP-12484(p.35-44)) MODIFICATION AND DOSIMETRY OF THE PLUTONIUM–BERYLLIUM NEUTRON IRRADIATION FACILITY. J. Doull, A. Sandberg, and D. G. Oldfield (Chicago. Univ. Air Force Radiation Lab.).

A description of modifications made in the fast neutron chronic irradiation facility with regard to the type of source, the source configuration, the type of exposure cage, and the arrangement of the exposure cages within the facility is presented. These modifications consist primarily in the replacement of the 200-curie polonium–beryllium point source with a 100-curie plutonium–beryllium line source and the use of a cylindrical, rather than a spherical, exposure cage array. Calculation of the neutron flux for the various exposure positions within the modified facility suggest that the modifications increased the number of animals which can be accommodated simultaneously in the facility and provide a sufficient range in dose rate for both present and future chronic irradiation programs in this laboratory. (auth)

13972 NP-12484(p.45-53)) EFFECT OF DOSE RATE ON LIFE SPAN SHORTENING OF MICE EXPOSED TO CHRONIC LOW LEVEL FAST NEUTRON IRRADIATION. A. Sandberg and J. Doull (Chicago. Univ. Air Force Radiation Lab.).

Two groups of CF_1 female mice were exposed to chronic fast neutron irradiation at dose rates of 0.24 and 1.66 rad/day throughout a duration of life radiation exposure program to obtain information on the life span shortening and histopathological effects of this type of radiation exposure. The median survival time of non-irradiated control mice was 53 weeks, while that of the irradiated groups was 41 weeks for the mice which received 1.66 rad/day and 51 weeks for the mice which received 0.24 rad/day. The group of mice exposed to 0.24 rad/day exhibited a life span shortening of 3.7% while the group which was exposed to 1.66 rad/day exhibited a 22.6% life span shortening. The slopes of the probit analysis curves increase as the radiation dose increases indicating an early initiation of death processes as well as an acceleration following their initiation. The RBE of gamma to fast neutrons as determined by the data differed for the various per cent life span shortening values, being greater at the low dose levels and decreasing at high dose levels. (auth)

13973 (NP-12484(p.54-62)) STUDIES ON THE TOXICITY OF RARE EARTH COMPOUNDS AND THEIR INFLUENCE ON RADIATION LETHALITY. David W. Bruce and Kenneth P. DuBois (Chicago. Univ. Air Force Radiation Lab.).

Intravenously administered praseodymium nitrate (2 mg/kg) produced an 11 to 13% increase in the endogenous respiration of spleen slices from female rats during the 24 to 72 hours after injection while 500 r of whole-body x-irradiation alone and in combination with praseodymium resulted in a 12 to 13% reduction in QO_2 values. A 34 to 63% increase in the toxicity of intravenously administered praseodymium nitrate (2 mg/kg) was observed when given 10 to 15 minutes prior to doses of whole-body x-irradiation ranging from 50 to 500 r. The intravenous administration of 2 or 4 mg/kg of praseodymium as the nitrate salt resulted in a proportional decrease with respect to time in the blood glucose of female rats during the 12- to 72-hour period following administration. At any given time during this period, the per cent decrease in blood glucose from control values was approximately twice as great in rats receiving 4 mg/kg of praseodymium. The subcutaneous administration of 5 mg/kg of testosterone propionate for 30 days prior to the intravenous injection of 2 mg/kg of praseodymium prevented or modified the resultant decrease in blood glucose normally seen after the administration of this compound. (auth)

13974 (NP-12484(p.63-93)) HISTOLOGICAL FINDINGS IN THE BLOOD VESSELS OF RATS AND MICE EXPOSED TO ACUTE AND CHRONIC X-IRRADIATION WHILE FED VARIOUS SYNTHETIC HIGH FAT DIETS. D. Vesselinovitch, R. W. Wissler, et al. (Chicago. Univ. Air Force Radiation Lab.).

A comparison of the histological findings in the cardiovascular system of mice and rats exposed to various doses of acute and chronic whole-body x-irradiation was made and the effects of various atherogenic and high-fat diets on these findings were investigated. Acute radiation exposure in the dosage range of 400 through 600 r of x radiation caused a loss of smooth muscle cells and calcification of the aortic media, calcification and hyalinization of the pulmonary arteries, and a mononuclear infiltration with necrosis and calcification of the myocardium. Hypercellularity of the valves of the heart was also observed. Combination of acute radiation exposure and the feeding of various atherogenic and high-fat diets did not result in a decrease in the sudanophilia or calcification of the blood vessels or any of the other diet-induced effects seen in the cardiovascular system of mice. Chronic radiation exposure at the rate of 20 or 40 r/day for a period of 12 weeks produced necrosis and fibrosis of the aorta in rats and a

mild hyalinization of collagen fibers in mice. Calcification of the coronary and testicular arteries was observed in both species. In the mice intimal lipid deposition was observed in the coronary arteries and there was also a fecal mononuclear infiltration in the myocardium. Combined exposure to chronic doses of x radiation and the feeding of the various atherogenic diets resulted in a decrease in the incidence and in the severity of the diet-induced blood vessel lesions, particularly the lipomatous changes. This was particularly true in the animals fed the Wilgram diet. The Wilgram diet-induced calcification of the aorta and other blood vessels in mice was also decreased by the chronic x-ray exposure. However, the incidence of thrombosis in the aorta and other arteries appeared to be increased in the animals exposed to chronic doses of x radiation. (auth)

13975 (NP-12484(p.94-115)) THE INFLUENCE OF VARIOUS CHEMICAL COMPOUNDS ON RADIATION LETHALITY IN MICE. V. Plzak, M. Root, and J. Doull (Chicago. Univ. Air Force Radiation Lab.).

Forty-three chemical compounds were tested for evidence of radioprotective activity. Of these, 18 showed slight to significant protective effects in that they permitted from 10 to 60% of the mice to survive for at least 30 days following the otherwise lethal whole-body x-ray exposure. (M.C.G.)

13976 (NP-12484(p.116-33)) FURTHER STUDIES ON THE MECHANISM OF RADIOPROTECTION AFFORDED BY CYANIDE AND VARIOUS NITRILES. J. Dilley and J. Doull (Chicago. Univ. Air Force Radiation Lab.).

The pre-irradiation administration of potassium cyanide at dosage levels equivalent to 2.25 mg/kg of HCN increased the LD_{50} of acute whole-body x-ray exposure from about 500 to over 900 r in CF_1 female mice. The ability of various cyanide producing nitriles to protect mice against lethal doses of whole-body x-irradiation appeared to depend on the ease with which they release free cyanide. The in vitro activity of rat liver transsulfurase was inhibited when the enzyme was exposed to x-ray doses of 800, 1,000, or 1,200 r in the presence of a substrate and cyanide, whereas radiation of the enzyme alone or in combination with the substrate only resulted in enhancement of its activity. A minor metabolite of cyanide, 2-imino-thiazolidine-4-carboxylic acid, was prepared by reacting cyanide and cystine and found to be capable of reducing radiation lethality in CF_1 female mice when given at 30 minutes following whole-body x-ray exposures in the range of 550 through 700 r. (auth)

13977 (NP-12484(p.134-58)) RADIOPROTECTIVE EFFECTS IN PROTON-IRRADIATED MICE PRETREATED WITH CHEMICAL PROTECTORS. D. G. Oldfield, J. Doull, et al. (Chicago. Univ. Air Force Radiation Lab.).

A method of proton and x-ray dosimetry using a Victoreen chamber charge-calibrated against a Co^{60} gamma source producing a known field is described. The radioprotective action of PAPP (p-aminopropiophenone) and MEA (2-mercaptoethylamine) against 30-day lethality and rate of death in CF_1 mice exposed to whole-body 440-Mev protons is described and compared with that for 250 Kvp x rays. (auth)

13978 (NP-12535) INVESTIGATIONS ON THE PROBLEM OF FORMATION AND PATHOPHYSIOLOGICAL SIGNIFICANCE OF BIOGENIC AMINES IN SUBLETHAL RADIATION INJURIES. Final Technical Report. Fr. Franzen (Cologne. Universität. Medizinische Klinik). [1962]. Contract DA-91-591-EUC-1978. 7p.

The effects of single whole-body doses of 400, 600, and 800 r x radiation on the levels of 7 amines in blood and urine were measured in rats. Levels of tryptamine, 5-hydroxytryptamine, bufotenine, histamine, 3-hydroxytryptamine, adrenaline, and noradrenaline were increased according to radiation dose. Functional tests showed that the amines had a marked influence on capillaries and small blood vessels, tissue respiration, and tissue gas levels. (C.H.)

13979 (TID-17581) THE EFFECT OF IONIZING RADIATION ON ENZYMATIC ACTIVITY AS FOUND IN THE KREBS CYCLE IN TETRAHYMENA PYRIFORMIS AT DIFFERENT STAGES OF CELL DIVISION. Progress Report No. 4, February 1, 1962–February 1, 1963. William D. Sullivan (Boston Coll., Chestnut Hill, Mass.). Contract AT(30-1)-2515. 38p.

Mass cultures of Tetrahymena pyriformis GL were grown in a chemically defined medium and were subjected to cyclic heat shock to induce synchronous division. Tritiated thymidine (1.0 μc/ml medium) was added during the last heat shock, 130 min before the onset of division. The addition of an increased amount of labeled thymidine (4.0 μc/ml) during the 8 hr of heat treatment caused excessive labeling. Liquid emulsion autoradiograms were prepared from samples fixed at the following intervals after heat treatment: 10 min before the onset of division, at the onset of division, and at the next two 10-min intervals during cleavage. Incorporation of thymidine was determined by silver grain counts. No set pattern in the distribution of DNA in the daughter nuclei was observed. The concentration of labeled thymidine in the nuclei of heat-treated cells was low as compared to that found in the nuclei of normal cells. Cytoplasmic labeling was observed, and its concentration appeared to increase toward late division. The index of division (82.6%) in the control cells was higher than that of the experimental cells (53.7%), which suggested a possible block caused by the addition of non-essential thymidine to the medium. The occurrence of prominent Feulgen positive particles in the cytoplasm of heat-treated cells was observed. (auth)

13980 (TID-17747) PROGRESS REPORT [ON RADIOBIOLOGY], MAY 16, 1962–DECEMBER 15, 1962. (Athens. Univ. School of Medicine). Contract AT(30-1)-2769. 24p.

Doses of 1000 r and 2500 r had no effect on the incorporation of acetate-1-C^{14} into the lipids of leukocytes in vitro, when incubation took place immediately after irradiation. A dose of 5000 r produced a small inhibition of about 5%. (C.H.)

13981 (TID-17837) EFFECTS OF IONIZING RADIATION IN CHIMPANZEES. Final Report, February 28, 1962–October 31, 1962. Arthur J. Riopelle and Charles M. Rogers (Yerkes Labs. of Primate Biology, Inc., Orange Park, Fla.). Contract AT(1441-)1553. 33p.

Results are reported from studies of the psychological, hematological, and pathological effects of a second dose of radiation to a group of chimpanzees irradiated several years before. The effects of a large dose of radiation to the head alone on previously nonirradiated animals were evaluated in 4 animals. Findings are summarized for each animal. No evidence of damage to neural tissue was seen following exposure to the head to 2000 r γ radiation. (C.H.)

13982 (TID-17890) PROGRESS REPORT [ON RADIATION AND ORGANISMS] FEBRUARY 1962 TO FEBRUARY 1963. (Smithsonian Institution. Div. of Radiation and Organisms, Washington, D. C.). Contract AT(30-1)-2373. 32p.

Progress is reported in studies on the interaction of

photomorphogenesis with the physiology of plant cells. Data are presented from studies on the effect of light pretreatment on starch degradation in etiolated leaves of corn seedlings of various lengths or ages, light-induced starch degradation in plastids of etiolated corn leaves, and the effect of pretreatment with monochromatic red and far-red radiant energy on leaf sections from etiolated corn seedlings. The effects of far-red radiation on chromosome aberrations induced by x radiation were studied in primary roots of Vicia faba. Data are included from studies on changes in somatic mutation frequencies and reduction in seedling height induced by 800 r x rays during germination of maize seed, protein synthesis associated with the formation of the complete photosynthetic system in bean leaves, the kinetics of light-stimulated growth in bean and lettuce seedlings, and biological responses of plants to photochemical reactions initiated by various portions of the spectrum of visible light. (C.H.)

13983 (TID-17911) RADIOAUTOGRAPHIC, HISTOCHEMICAL, AND BIOCHEMICAL STUDIES OF THE EFFECTS OF IRRADIATION ON CARTILAGE AND BONE. Progress Report, February 15, 1962–January 1, 1963. Albert Hirschman (New York. State Univ., New York. Downstate Medical Center). Contract AT(30-1)-2960. 7p.

Progress is reported in tracer studies on the effects of x radiation on the intracellular synthesis of sulfated mucopolysaccharides in the epiphyseal cartilage of young rats, the fractionation of sulfated mucopolysaccharides in cartilage and bone, and histochemical studies of the metachromatic granules of epiphyseal cartilage. The uptake of tritiated proline and cytidine was studied in normal rats. (C.H.)

13984 (TID-18003) DELAYED EFFECTS OF X-IRRADIATION ON THE CENTRAL NERVOUS SYSTEM OF THE MONKEY. Annual Progress Report. (Columbia Univ., New York. Coll. of Physicians and Surgeons). Feb. 12, 1963. Contract [AT(30-1)-3014]. 10p.

Three young monkeys received 3500 r x radiation to the right cerebrum in a single exposure. The animals were sacrificed 4 months later. Histopathological changes ranged from severe necrobiosis at the center of the absorbing area to a zone of vascular proliferation at the periphery. Results are reported from histopathological and electron microscopy studies of the central nervous system. (C.H.)

13985 (TID-18018) PERIPHERAL BLOOD STUDIES UPON RADIATION CHIMERAS. Technical Report on the Work Done Since February 1962. A. M. Cross, A. J. S. Davies, and S. M. A. Doak (International Atomic Energy Agency, Vienna). Contract IAEA 103/US. 15p.

Mice were subjected to 300, 500, or 700 r x radiation and either left untreated or given injections of bone marrow obtained from the femurs of donor mice. Data are presented on the blood picture at various times after treatment and on survival at 30 days. The effect of irradiation was proportional to the radiation dose and in all cases injection of bone marrow effected a rapid restoration of peripheral blood values toward normal. (C.H.)

13986 (UCLA-510) SEMIANNUAL PROGRESS REPORT [ON RADIOBIOLOGY] FOR THE PERIOD ENDING DECEMBER 31, 1962. (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology). Contract AT(04-1)-Gen-12. 89p.

Biochemistry: Progress is reported in studies on alterations in brain lipids with aging and irradiation; investigations on lipids of the starfish, Pisaster ochraceus; the constituents of the leaf cuticle wax of the ornamental rubber plant, Ficus elastica; interactions of blood serum with synthetic polypeptides; and investigations on the source of energy for single beating heart cells. Radiobiology: Progress is reported in studies on the effects of γ radiation on aqueous solutions of pyrimidine compounds and cysteine, tracer studies of phosphate and sulfur metabolism in chlorella, the morphology and physiology of mitochondria, and photosynthesis and respiration in Euglena gracilis. Pharmacology and Toxicology: The radioprotective activity of 204 amines and amine oxide compounds was investigated and the relation between structure and protective activity is discussed. Progress is reported in studies on the effect of psychotropic drugs on the kangaroo rat and the effect of irradiation on intestinal absorption of nicotinamide by rats. Nuclear Radiology: Applications of radioisotope tracer methods in the diagnosis and management of liver and kidney diseases are reported. Progress is reported in the photoscanning of the stomach, heart, liver, and spleen following intravenous injection of inorganic radioiodine or of colloidal aggregates of human serum albumin labeled with I^{131}; studies on the antigenicity of colloidal aggregates; animal studies on renal artery occlusion; and studies on the retention of I^{131} labeled human serum albumin and the absorption of Ca^{47} in man. The effects of pretreatment with aminoethylisothiuronium or 5-hydroxytryptamine on survival of irradiated rats were measured. A total of 24 newborn infants was examined in a whole-body counter for radioiodine contamination. No radioiodine or any other radionuclides, except K^{40}, was observed. Medicine: Data are summarized from studies on the role of desoxyribonucleic acid and the thymus in leukemogenesis in mice, the development of radioinduced leukemia in mice protected with bone marrow, spleen, and thymus cells from a strain of mice with a high incidence of leukemia, and the oncogenic properties of desoxyribonucleic acid isolated from parotid gland tumors in mice. Biophysics: Progress is reported in studies on lymphopenia in mice induced by tail irradiation. Environmental Radiation: Data are summarized from a series of studies on the ecological effects of environmental radiation due to fallout. Results are included from studies on the effects of a nuclear detonation on desert vegetation and animal populations. (C.H.)

13987 (UR-621) THE CONSTANCY OF REPAIR RATE AND OF IRREPARABILITY DURING PROTRACTED EXPOSURE TO IONIZING RADIATION. Henry A. Blair (Rochester, N. Y. Univ. Atomic Energy Project). Dec. 3, 1962. Contract W-7401-eng-49. 14p.

Data on protracted exposure of mice to ionizing radiation at various constant daily rates are analysed with respect to the question of whether recovery rate per unit of injury and the irreparable component of injury per unit dose are dependent upon the rate and duration of exposure. It is concluded that recovery rate does not depend on dose rate or duration of exposure. Irreparability, however, in one set of data is greater at high dose rate than at low, while in the other it is independent of dose rate. Since the latter effect is simpler it is concluded that it is probably the more general. (auth)

13988 (JPRS-17819) PATHOLOGICAL PHYSIOLOGY AND EXPERIMENTAL THERAPY. Translation of Patologicheskaya Fiziologiya i Eksperimental'naya Terapiya, 6: No. 6, 3-10; 44-56(1962). 36p.

Translations are presented of 4 articles from the Russian language medical journal, Pathological Physiology and Experimental Therapy. (C.H.)

13989 (JPRS-17819(p.1-14)) THE POSSIBILITY OF MODELING CERTAIN CONGENITAL DISEASES. I. A. Piontkovskii (Piontkovskiy). Translated from Patol. Viziol. i Eksperim. Terapiya, 6: No. 6, 3-10(1962).

A study was made on the effects of irradiation during embryogenesis on the development of the central nervous system in rats, rabbits, and dogs. Results are compared with congenital diseases of the central nervous system. It is pointed out that other pathogenic factors during the prenatal period may also induce congenital diseases. The diseases discussed are those that are similar to those encountered in human pediatric practice. (C.H.)

13990 (JPRS-17819(p.15-24)) TREATMENT OF ACUTE RADIATION SICKNESS BY THE METHOD OF TRANSPLANTING COLD-PRESERVED HOMOLOGOUS BONE MARROW. V. A. Revis. Translated from Patol. Fiziol. i Eksperim. Terapiya, 6: No. 6, 44-9(1962).

It was shown that the preservation of bone marrow by means of freezing in glycerin at −75°C for 24 hr, with subsequent maintenance at −15° for 10 to 25 days, ensured good preservation. Subcutaneous injection of preserved bone marrow within 24 hr of exposure of rabbits to 1100 r x radiation increased the survival rate and reduced symptoms of radiation injury. (C.H.)

13991 (JPRS-17819(p.25-31)) EXPERIENCE OF USING S, BETA-AMINOETHYLISOTHIOURONIUM IN THE PROPHYLAXIS OF EXPERIMENTAL ACUTE RADIATION SICKNESS. V. A. Razorenova. Translated from Patol. Fiziol. i Eksperim. Terapiya, 6: No. 6, 49-53(1962)

The protective effects of aminoethylisothiouronium (AET) in the treatment of acute radiation sickness were investigated in mice, rats, and dogs. AET was found to possess marked protective properties only in experiments on mice. A mild prophylactic effect was observed in rats and dogs when AET was given 30 to 120 min before exposure to doses of 750 r and 350 r Co^{60} γ radiation. (C.H.)

13992 (JPRS-17819(p.32-6)) CHARACTERISTICS OF HETEROHEMOTRANSFUSION REACTIONS IN IRRADIATED RATS. R. F. Yurin. Translated from Patol. Fiziol. i Eksperim. Terapiya, 6: No. 6, 54-6(1962).

The effects of whole-body x irradiation on the response of rats to heterohemotransfusion reactions were measured for various time intervals after the administration of dog's blood to irradiated rats. Mortality was found to increase 4 weeks following irradiation. The mortality rate from heterohemotransfusion was found to be higher in acute than in chronic experiments. (C.H.)

13993 CHARACTERISTICS OF THE DEVELOPMENT OF COMPENSATORY MECHANISMS BY THE ORGANISM IN RESPONSE TO IONIZING RADIATION. A. W. Lebedinski and J. G. Grigorjew. Acta Biol. Med. Ger., 6: 189-201 (1961). (In Russian)

The biological effects of small doses of radiation are discussed, particularly with respect to tissue regeneration and development of protective reactions. Initial changes from subiethal and lethal doses in the central nervous system are considered. The effect of unilateral labyrinthectomy with subsequent compensatory reactions aiding restoration of neural function is compared with central nervous reactions in dogs during the acute radiation syndrome. (H.H.D.)

13994 RELATIONSHIP OF LEUKEMIA IN CHILDREN TO ABDOMINAL IRRADIATION OF MOTHERS DURING PREGNANCY. Josephine Wells and Charles M. Steer (Presbyterian Hospital, New York). Am. J. Obstet. Gynecol., 81: 1059-63(May 1961).

The frequency of x-ray examination of the abdomen during pregnancy in the mothers of a group of children who died of leukemia was compared with the frequency of x ray of mothers of a control group of children. Among 77 mothers of children who died of leukemia, prenatal abdominal x-ray examination was carried out in 4, an incidence of 5.2%. Among the 156 controls, abdominal x-ray examination was carried out in 11, an incidence of 7.1%. Because of the small sample, the figures neither prove nor disprove a relation between x-ray examination of the abdomen during pregnancy and subsequent development of leukemia in the child. It was concluded that x-ray examination should continue to be performed during pregnancy in those cases in which clinical examination determined the need for it, but that attempts be made to reduce prenatal exposure to minimal levels. (P.C.H.)

13995 HEMOPOIETIC RESTORATION IN LETHALLY X-IRRADIATED MICE INJECTED WITH PERITONEAL CELLS. Leonard J. Cole (U. S. Naval Radiological Defense Lab., San Francisco). Am. J. Physiol., 204: 265-7(Feb. 1963).

The capacity of intravenously injected cells from peritoneal fluid, peripheral blood, lymph nodes, thymus, and bone marrow of mice to restore hematopoiesis in lethally x irradiated (880 rad) isogenic recipients, was investigated. Thirty-day survival and visible colony formation in the spleen were employed as the criteria. Administration of 6×10^6 or 11×10^6 peritoneal cells, and 6.4×10^6 or 15×10^6 peripheral leukocytes afforded protection against mortality, and elicited colonies in the spleen; comparable effects were observed after injection of 1.1×10^5 marrow cells. The injection of 34×10^6 adult lymph node cells or of 9×10^6 thymus cells from newborn mice had no effect on mortality, nor did they elicit spleen colony formation. A correlation appears to exist between the capacity of isogenic cells to restore hemopoiesis in lethally irradiated mice, and their ability to elicit visible colony formation in the spleen. Evidently normal peritoneal cell populations and peripheral blood leukocytes contain hemopoietic stem-cell elements, with a frequency 30 to 50 times lower than among bone marrow cells. No evidence was adduced to support the concept that normal lymphoid tissue lymphocytes give rise to hemopoietic cell lines. (auth)

13996 THYROID CANCER FOLLOWING IRRADIATION FOR MEDULLOBLASTOMA. A. Raventos and Diana O. Duszynski (Univ. of Pennsylvania, Philadelphia, and Children's Hospital of Buffalo). Am. J. Roentgenol., Radium Therapy Nucl. Med., 89: 175-81(Jan. 1963).

Two cases of thyroid carcinoma, appearing 7 and 11 years after therapeutic irradiation for medulloblastoma, are presented. Only 3 additional cases of thyroid cancer following irradiation for cancer were found in the literature, as contrasted to 282 in patients treated for benign conditions. At present, this sequence appears largely limited to children and young adults, but there is histologic evidence that the adult human thyroid is not invulnerable to irradiation. Further search may show irradiation histories to be more common in adult thyroid cancer patients than has so far been demonstrated. The fact that the irradiation was given for benign conditions in nearly all the cases reported to have developed thyroid cancer subsequently is inconclusive in the absence of epidemiologic data on radiation therapy usage. However, analogies to radiation carcinogenesis in animal thyroid glands suggest that differences in irradiation technique, such as dose and time patterns, might play some part. The problems discussed here indicate a need for more diligent search for irradia-

tion histories in cancer patients, more critical examination of irradiated patients for possible neoplasms, and more detailed reporting of radiation factors in cases of suspected radiation injury. (auth)

13997 THE IMPACT OF IONIZING RADIATIONS ON THE EMBRYO AND FETUS. Roberts Rugh (Columbia Univ., New York). Am. J. Roentgenol., Radium Therapy Nucl. Med., 89: 182-90(Jan. 1963).

Data are presented on the major abnormalities found in mice, rats, and humans following exposure of the embryo or fetus to ionizing radiations. A schematic representation is included of the role of desoxyribonucleic acid and ribonucleic acid in protein synthesis in embryonic cells. The effects of the radiosensitivity of desoxyribonucleic acid synthesis on the induction of anomalies in the embryo or fetus are discussed. It is pointed out that radioinduced congenital abnomalies should be regarded as expressions of loss or failure of certain structures to develop rather than as the appearance of additional, new, and grotesque structures. Some gross cellular changes caused by ionizing radiations are probably permanent, irrevocable, and irreparable so that the organism as a whole rejects them and continues to develop without them if it can. This leads to changes that are most graphic when they involve the central nervous system. Anomalies of the nervous system may result from exposure at any time from fertilization of the egg to the completion of development after birth. Damage to the central nervous system in late development may be revealed only by functional tests such as electroencephalography, electroretinography, psychologic behavior, and intelligence tests. (C.H.)

13998 ACUTE MYELOGENOUS LEUKEMIA COMPLICATING RADIOACTIVE IODINE THERAPY OF THYROID CANCER. REPORT OF A CASE. Charles G. Lewallen and John T. Godwin (Brookhaven National Lab., Upton, N. Y. and National Inst. of Arthritis and Metabolic Diseases, Bethesda, Md.). Am. J. Roentgenol., Radium Therapy Nucl. Med., 89: 610-17(Mar. 1963).

The clinical, hematologic, and pathologic findings of a patient with thyroid cancer who developed leukemia following radioactive iodine therapy are presented. With respect to iodine metabolism, the tumor was highly functional and histologically was well differentiated. The metastatic deposits were primarily skeletal. Acute myelogenous leukemia of the aleukemic variety developed after the patient had received a total of 805 mC of I^{131} therapeutically over a 4-yr period. The total radiation dose to the blood was estimated to be 1600 rads. The total biologically effective radiation dose to the bone marrow was estimated to be about 44% of the radiation dose to the blood. The clinical and hematologic features of the case consonant with a radiation etiology of the leukemia are discussed and reference is made to 9 additional cases in which leukemia complicating radioactive iodine therapy of thyroid cancer was previously described. (P.C.H.)

13999 SOME OBSERVATIONS ON RADIATION DOSE TO BONE MARROW DURING I^{131} THERAPY OF THYROID CANCER. Charles G. Lewallen (Brookhaven National Lab., Upton, N. Y. and National Inst. of Arthritis and Metabolic Diseases, Bethesda, Md.). Am. J. Roentgenol., Radium Therapy Nucl. Med., 89: 618-23(Mar. 1963).

Dose data for a case of leukemia complicating I^{131} therapy are recorded and evidence that the biologically effective bone marrow dose is substantially less than the blood dose during I^{131} therapy of thyroid cancer is presented. The factors contributing to the difference in blood and bone marrow dose are discussed. (P.C.H.)

14000 THE SUCCESSIVE CHANGES IN THE SKIN EPITHELIUM OF THE YOUNG AXOLOTL (SIREDON MEXICANUM) AFTER ROENTGEN IRRADIATION. V. V. Brunst (Roswell Park Memorial Inst., Buffalo). Am. J. Roentgenol., Radium Therapy Nucl. Med., 89: 624-47 (Mar. 1963).

The heads of 127 animals from one spawning were irradiated 14 days after hatching with: 9000, 6000, 3000, 1000, 500, and 250 r, while 20 animals served as untreated controls. As the amount of radiation increased, the number of days before enlarged epithelium cells were observed was decreased. For example: 21 days after irradiation with 1000 r, the cells of the epithelium were definitely enlarged, but only 17 days after irradiation 3000 r, the epithelial greatly enlarged. The threshold of sensitivity of skin epithelium is between 250 and 500 r. Giant epithelial cells were in some cases 7 to 8 times larger than the normal cells of control animals of the same age. They were 5 to 6 times larger than the other epithelial cells of the same animal in close proximity. The nuclei of the giant cells were much larger than the nuclei of normal epithelial cells. The maximal size and maximal development of the giant cell epithelium were observed after irradiation with medium doses. (P.C.H.)

14001 INFLUENCE OF ROENTGEN IRRADIATION OF AUTOLOGOUS BLOOD IN VITRO ON MITOTIC RATE AND BLOOD CELL COUNT IN RATS. A. Voutilainen and H. Maehoenen (Univ. of Helsinki, Finland). Ann. Med. Exptl. Biol. Fenniae (Helsinki), 39: 104-9(1961).

One ml of blood was withdrawn from 3-month-old rats and irradiated in vitro with 5000, 10000, or 25000 r x radiation. It was immediately reinjected in the same rat from which it was withdrawn. Two days later biopsy specimens were taken from the skin, forestomach, glandular stomach, and ileum, and the number of mitoses were counted. Blood samples were also withdrawn and counts of red and white blood cells were made. The irradiation effect was slight and statistically insignificant, showing that roentgen irradiation of blood in vitro releases neither mitosis-stimulating nor -inhibiting factors, not even when given at fairly high dosage, in contradistinction to what has been concluded from experiments in vivo. The leukocytosis that was noted in some animals was interpreted as being due to inflammatory factors arising from the reinjection of blood. (H.H.D.)

14002 SURVIVAL OF RATS AFTER PARTIAL AND WHOLE BODY IRRADIATION WITH FRACTIONATED X-RAY DOSES. H. Hou and A. Dunjic (Institut du Cancer, Louvain, Belg.). Ann. Radiol., 5: R225-9(1962). (In French)

Irradiation of the head, thorax, or abdomen of rats with a total dose of 600 r of x rays, delivered in 12 doses of 50 r each, does not shorten life, as was demonstrated previously in the case of single doses of the same order of magnitude. The incidence of cancer is increased only in rats which have received repeated irradiation of the abdomen. These results correspond to what the authors predicted from their study of the relationship between the dose of irradiation and the shortening of life in animals given whole body irradiation in single and fractionated doses of x or gamma rays. (auth)

14003 THE CHRONIC HAZARD IN RABBITS FED WITH CLOVER CONTAMINATED BY FALLOUT. Kazuo Nishio, Sakiko Sugiura, Atsuhiko Takeda, Iwashiro Oki, Tyizuko Nishio, and Toshiya Miyamoto. Ann. Rept. Radiation Center Osaka Prefect., 1: 51-65(1960). (In English)

Rabbits fed only with clover were selected for study since

grass-eating animals would be contaminated most intensely through exposure to fallout. Sr-90 was detected in Sept. 1958, at levels of 4200-6500 strontium units in ashes of newborn from mothers that had fed only on clover since birth in Feb. 1957. These animals were subjected to clinical tests with respect to radiation hazard. Up to the end of 1960, no signs of distinct hazard due to irradiation were detected, but problems remain that would preclude the acceptance of the theory that such contaminations have no effect on these experimental animals. (H.G.G.)

14004 DEVELOPMENT OF RADIATION PNEUMONITIS; TIME AND DOSE FACTORS. F. L. Jennings and A. Arden (Univ. of Texas, Galveston). Arch. Pathol., 74: 351-60(Oct. 1962).

Histologic evaluation of the lungs was done at autopsy in 215 patients who had received thoracic radiation. The presence or absence of tissue changes noted were: edema, congestion, atelectasis, fibrin exudate in alveoli, epithelial changes, fibrillar thickening of alveolar septa, increased cellularity of alveolar septa, fibrosis of alveolar septa, and proliferative changes in blood vessels. Some or all of the tissue changes listed were found in 165 cases. Two changes were particularly frequent: accumulation of a fibrin-rich exudate within alveoli, often forming a membrane in the alveoli, and thickening of alveolar septa, either by accumulation of fibrillar material, by cellular proliferation, or by increase of fibrous tissue. Such fibrin accumulations were found at radiation doses below 500 r and in excess of 6000 r, and at postirradiation intervals of less than 30 days and over 5 yr. Fibrin accumulations formed within 90 days after less than 1500-r x-ray exposure were similar to those seen almost 9 yr after 5000 r. Three separate types of proliferative changes in the connective tissue of the alveolar septa appeared to be secondary to radiation; 27% showed a fibrillar deposit in the septa which tended to thicken the septa markedly. The time interval appeared to make little difference in the development of this lesion. Increased septal cellularity, due primarily to accumulation of histiocytes and fibroblasts, was seen in 16% of the cases, most commonly at doses between 2000 r and 5000 r. Fibrosis of alveolar septa was the third type of proliferative change and was seen in 42% of the cases. (P.C.H.)

14005 LOSS OF VIABILITY AND β-GALACTOSIDASE-FORMING ABILITY AS A CONSEQUENCE OF TRITIUM DECAY IN ESCHERICHIA COLI. Martin Rachmeler and Arthur B. Pardee (Univ. of California, Berkeley). Biochim. Biophys. Acta, 68: 62-7(Jan. 29, 1963). (In English)

Decay of tritium incorporated into Escherichia coli prevented the bacteria from growing into colonies or from forming β-galactosidase. The rate of viability loss was similar when the H^3 was incorporated into DNA or into total nucleic acids. The somewhat slower rate of inactivation by H^3 incorporated into proteins was attributed to a geometrical factor. Ionizations caused by the emitted β-particles are thought to be primarily responsible for viability loss. Decays of H^3 in DNA were much more effective in preventing β-galactosidase formation than were decays in RNA or protein. Loss of enzyme-forming ability was attributed to recoil damage in the DNA. The similar sensitivities of viability and enzyme formation appear coincidental, since they were caused by different consequences of H^3 decay. Mated bacteria were prepared, radioactive in all parts except the genetic material carrying specificity for β-galactosidase formation. Viability but not enzyme formation was sensitive to H^3 decay. This suggests that only H^3 decays in the specificity-carrying chromosome inactive enzyme-forming ability. (auth)

14006 COMPOUND SURVIVAL CURVE OF VACCINIA-VIRUS AFTER GAMMA RADIATION. R. Palacios (Instituto Bacteriólogico de Chile, Santiago), G. Contreras, R. Espejo, R. Jiménez, A. Ohlbaum, and J. Tohá. Biochim. Biophys. Acta, 68: 149-51(Jan. 29, 1963). (In English)

The effects of gamma radiation on the inactivation of vaccinia Lancy strain was studied. The inactivation curve of vaccinia virus does not follow a simple exponential function and can be resolved into two components. A 37% dose, D_{37}, for the more radiosensitive component is $3.5 \times 10^4 \pm 0.23 \times 10^4$R, giving a target volume of 3.7×10^{-17}. The D_{37} for the more radioresistant is $3.1 \times 10^5 \pm 0.5 \times 10^5$R, and a target volume of 4.3×10^{-18} cm^3. The different radiosensitivities were not influenced by changes in the suspending medium, because its replacement by fresh medium did not alter the rate of inactivation. Speculation is given on the mechanisms of the observed two-components inactivation curve. The results do not exclude the possibility that changes in the viral protein could account for the different rates of inactivation. (P.C.H.)

14007 STUDY OF THE CHANGES IN LYMPHOCYTE POLYSACCHARIDES AND SERUM GLYCOPROTEINS IN PATIENTS SUBJECTED TO ROENTGEN THERAPY. L. Verga, M. Garofano, and F. Coucourde (Università, Pavia, Italy). Boll. Soc. Ital. Biol. Sper., 37: 101-3 (Feb. 15, 1961).

Studies were conducted on 10 patients with pulmonary and mammary cancer, Hodgkin's disease, or leukemia who were recovering from 200-kv x-ray therapy (single daily doses of 100 to 200 r and total doses of 1100 to 15000 r). Lymphocyte polysaccharide content was determined in peripheral cells by the periodic acid-Schiff histochemical technique, and serum glycoprotein were examined electrophoretically in paper strips stained by the same reaction. Circulating lymphocyte counts fell in all patients to levels 30 to 50% below pretreatment values. This was accompanied by a 150 to 200% rise in the polysaccharide content of the cytoplasm of individual cells. The material was only partly digested by takadiastase, showing that it is not glycogen. The changes in serum glycoproteins were not very consistent but, in general, glycoprotein content tended to be increased by irradiation in the α_1- and γ-globulin fractions and decreased in the albumin and α_2- and β-globulin fractions. Neither the polysaccharide changes in lymphocytes nor the glycoprotein changes in serum could be correlated with the radiation dose. The finding in lymphocytes suggest that radiation may have stimulated cytoplasmic metabolic function in surviving or regenerate cells. (H.H.D.)

14008 STUDY OF THE CHANGES IN LYMPHOCYTE POLYSACCHARIDES AND SERUM GLYCOPROTEINS IN GUINEA PIGS SUBJECTED TO TOTAL-BODY IRRADIATION IN SUBLETHAL DOSES. L. Verga, F. Coucourde, and B. Bonferoni (Università, Pavia, Italy). Boll. Soc. Ital. Biol. Sper., 37: 104-6(Feb. 15, 1961).

Radiation effects on lymphocyte polysaccharides and serum glycoproteins were investigated in guinea pigs. The animals were given a single, whole-body 500-r dose of 180-kv x irradiation and humoral changes were examined before, immediately after, and 10, 20, and 30 days after irradiation. The number of circulating lymphocytes fell to 10 to 15% of the initial value by the 10th day and reached a very low level by the 30th day. Lymphocyte polysaccharide content fell after irradiation, the lowest value being reached on the 10th day. Changes in serum glycoproteins were most marked on the 10th day: increases were noted in these components in the albumin (16.6%) and α_1-globulin (25.3%) fractions and decreases in α_2- (27.9%), β- (9.2%),

and γ-globulin (4.8%) fractions. The levels returned to normal by the 30th day. This shows that the α-glycoproteins are markedly altered by irradiation. The more pronounced glycoprotein changes in guinea pigs as compared with irradiated humans may reflect the higher acute doses used in the animals; moreover, the higher doses might be expected to produce more injury to the lymphocytes than the fractionated doses in humans. (P.C.H.)

14009 THE ULTRAVIOLET-INDUCED VARIATIONS IN ASPERGILLUS TERREUS, THEIR MORPHOLOGICAL CHANGES, AND THEIR PRODUCTION OF ITACONIC ACID FROM MOLASSES. June C. Y. Tsao, Ting-chia Huang, Shirley Chung-hua Su (Taiwan Provincial Cheng Kung Univ., Tainan, China). Botan. Bull. Acad. Sinica, 3: 1-17(Jan. 1962). (In English)

The method used for the production of variations in Aspergillus terreus, NRRL, 1960 by ultraviolet radiation is described. With the energy of the short wave 2537 Å ultraviolet radiation for a period of one hour to two hours exposure over 95% of the spores from the parent strain are found killed or depressed and only less than 5% in the average survived within 3 to 5 days. Nearly all the spores survived after the irradiation was changed. Seventeen morphologically different types of variants were isolated, incubated, subcultured, and microscopically studied. The probability of how these variants are induced by the energy produced by the short wave ultraviolet radiation is discussed. In general, the ultraviolet-induced variants produce biochemically more itaconic acid from molasses than the unirradiated parent strain. (auth)

14010 GENIC ANALYSIS IN RICE. III. INHERITANCE OF MUTATIONS INDUCED BY IRRADIATIONS IN RICE. Sung-ching Hsieh (Taiwan Agricultural Research Inst., Taipei, China). Botan. Bull. Acad. Sinica, 3: 151-62(July 1962). (In English)

From 150 mutant strains of rice induced by radiations, 21 were picked out for genetical study. They were intercrossed or crossed with the normal strains, and the segregation pattern of various traits in F_2 were investigated. Most of the mutant characters such as dwarfness, spreading panicle, narrow-rolled leaf, etc., showed monogenic inheritance. In an intercross of two dwarfs, the F_1 showed normal plant height, but in F_2 9 normal, 3 dwarf-I, 3 dwarf-II and 1 double recessive dwarf were segregated, indicating that dwarf-I and dwarf-II had different genes for their dwarfness which were independent of each other. Linkage between genes is discussed. (auth)

14011 TREATMENT OF AKR MICE AT THE AGE OF SIX MONTHS WITH WHOLE-BODY IRRADIATION FOLLOWED BY TRANSFUSION OF ALLOGENIC HEMATOPOIETIC CELLS; RESPECTIVE INCIDENCE OF LEUKEMIA AND SECONDARY SYNDROME. G. Mathé, J. L. Amiel, and Jean Bernard (Centre de Recherches de l'Association Claude Bernard, Hospital Saint Louis, Paris). Bull. Assoc. Franc. Etude Cancer, 47: 331-40(July-Sept. 1960).

Mice were given lethal (750-r) doses of x rays and some were subsequently transfused with bone marrow cells from fetal or adult C3H or C57B16 mice. Although the treated animals only rarely died from leukemia, in contrast to control mice, their survival time (7.4 months) was shorter than the controls. The cause of death in the mice was usually the secondary syndrome or homologous disease, resulting from immunologic incompatibility between the donor myeloid cells and host tissues. Incidences of secondary syndrome and leukemia were the same whether fetal or adult donor cells were used. However, the strain of the donor did affect the incidences; the secondary syndrome was less frequent and leukemia more prevalent when the donor and recipient mice shared the H2 histocompatibility gene. The results are in conflict with previous reports that secondary disease does not follow injection of fetal cells. In other experiments it was demonstrated that runt disease is produced when fetal DBA2 mouse myeloid cells are injected in newborn C57B16 mice. (P.C.H.)

14012 TUMORS OBSERVED IN THE HAMSTER AFTER WHOLE-BODY IRRADIATION BY MEANS OF X RAYS. M. R. Rivière, I. Chouroulinkov, and M. Guérin. Bull. Assoc. Franc. Etude Cancer, 47: 542-57(Oct.-Dec. 1960).

The carcinogenic action of ionizing radiation was investigated in 80 2- to 5-month-old hamsters (Mesocricetus auratus), which were submitted to 3 different doses of 200-kv x rays. Twenty animals received single whole-body doses of 300 r, 20 were given single doses of 600 r, and 40 received a total of 600 r given in 4 weekly doses of 150 r each. Within 8 to 10 months, 9 of the 80 hamsters developed generalized lymphomatosis. The incidence of the malignancy in the 3 groups was 5, 10, and 15%, respectively. It was not influenced by the sex of the animals since it developed in 5 females and 4 males. Lymphosarcomas were found throughout the lymph nodes and as metastases in many organs; the histologic appearance of the tumors was the same in all cases. A large proportion of mitotic figures was present and voluminous cells resembling pseudoplasmacytes predominated. It was concluded on the basis of the results that x radiation is capable of inducing the tumors in the hamster. Several other tumors were noted in the irradiated animals, including 2 uterine epitheliomas, a nevocarcinoma, an ovarian fibroma, a parathyroid adenoma, and several hepatic cholangiomas. (H.H.D.)

14013 CYTOPHOTOMETRIC STUDY OF THE DEOXYRIBONUCLEIC ACID CONTENT OF CELLS IRRADIATED IN VITRO (HeLa CELLS AND RABBIT FIBROBLASTS). T. Constantin, H. Febvre, C. Herovici, C. Lalanne, and C. Vendrely (Institut de Recherches sur le Cancer, Villejuif, France). Bull. Assoc. Franc. Etude Cancer, 47: 585-96(Oct.-Dec. 1960).

HeLa cells and rabbits fibroblasts of the T.L.H. strain were irradiated with 300 to 2000 r of 200-kv x rays. Fibroblasts given more than 1000 r did not survive the 3- to 6-week observation period so that a standard dose of 600 r was generally used. After 600 r, practically no growth was seen in cultures of cells of both types. DNA content of irradiated cells was determined cytophotometrically and expressed in arbitrary units (100 A.U. = 6.4×10^{-9} mg DNA, 200 A.U. corresponding to the normal complement of diploid cells). In contrast to the average level of 200 A.U. in nonirradiated HeLa cells, irradiated cells showed a wider distribution of levels, from 75 to 900 A.U., within 9 hr of irradiation. This indicates an increased frequency of hypoploid as well as polyploid cells after irradiation. Three days after irradiation, DNA values up to 1400 A.U. per cell were noted. The average diameter of HeLa cells irradiated with 600 r was 25 μ, compared with the control value of 17 μ; thus, irradiation caused a 2- to 3-fold increase in nuclear volume. On this basis, the DNA concentration in the nucleus of irradiated cells is actually less than that in control cells 3 weeks after irradiation. The results indicate that radiation inhibits mitotic division of cells without interfering with DNA synthesis. (H.H.D.)

14014 EFFECT OF ^{60}Co GAMMA RAYS ON THE NUCLEIC ACIDS CONTENT AND DN-ase II ACTIVITY IN THE LIVER AND SPLEEN OF CHICK EMBRYO. M. M. Jovanović, Z. A. Knežević, and N. B. Svećenski. Bull.

Inst. Nucl. Sci. "Boris Kidrich" (Belgrade), 13: No. 4, 43-7(Dec. 1962).

The effects of gamma radiation on the content of nucleic acids and the activity of DNase in the liver and spleen of chick embryos were investigated. The DNase II activity in the liver decreased 24 hr after irradiation, while the activity of the enzyme in the spleen increased by 36% as compared to the controls. The level of both nucleic acids was significantly depressed in the liver, 24 hr after irradiation. (P.C.H.)

14015 INFLUENCE OF A MODERATE DOSE OF ^{60}Co GAMMA RAYS ON THE GLYCOGENE CONTENT IN CHICK EMBRYO LIVER. M. M. Jovanović, Z. A. Knežević, and N. B. Svećenski. Bull. Inst. Nucl. Sci. "Boris Kidrich" (Belgrade), 13: No. 4, 49-52(Dec. 1962).

The effects of gamma radiation on the liver glycogen content of chick embryos were investigated. The results indicated that as far as the glycogen content of the liver is concerned, the chick embryos behave like adult mammals after irradiation and after the application of ACTH and cysteamine. However, a dose of 460 r combined with cortisone increased the glycogen content in the liver during the first 24 hr after the treatment, while cysteamine inhibited the deposition of glycogen when used together with radiation; cortisone and cysteamine diminished glycogen reserves in the embryo of normal chicks. (P.C.H.)

14016 THE EFFECT OF ELECTROMAGNETIC RADIATIONS ON PROTEINS. I. ENZYMATIC HYDROLYSIS OF SERUM ALBUMIN AFTER GAMMA IRRADIATION IN AQUEOUS SOLUTION. C. Colson and E. Fredericq (Université, Liege). Bull. Soc. Chim. Belges, 71: 492-502(Sept.–Oct. 1962). (In French)

Bovine serum albumin was irradiated in aqueous solutions by gamma rays from a Co^{60} source, at dose rates varying between 5,000 and 60,000 rad per hour. An increase in absorbancy is brought about in the absorption band of aromatic amino acids. A moderate increase in asymmetry is evidenced by viscosity measurements at total doses below 100,000 rad. For high doses, asymmetry strongly increases and precipitation takes place. The hydrolysis of irradiated samples by pepsin, trypsin, and chymotrypsin was measured by titration with a pH-stat or by precipitation with trichloracetic acid. It was found that the rate of hydrolysis by pepsin and chymotrypsin decreased in proportion to the time of irradiation. This was attributed to the modifications produced in aromatic rings by irradiation, since the enzymes used are specific for bonds neighboring such aminoacids. On the contrary, trypsin, which does not have these requirements, is more active on irradiated samples. This could be related, partly at least, to the partial denaturation brought about in serumalbumin by gamma rays. (auth)

14017 EPIDEMIOLOGY OF LEUKEMIA: BACKGROUND FOR FUTURE STUDIES. Brian MacMahon (Harvard School of Public Health, Boston). Bull. World Health Organ., 26: 579-84(1962).

The possibilities of relating leukemia incidence to natural radioactivity and to exposure from medical sources of ionizing radiation are discussed. The relation between terrestrial background radiation and leukemia mortality was investigated in northern New England. Age-adjusted leukemia mortality rates were determined for 4 background radiation categories. No statistically significant association between level of background radiation and leukemia mortality was demonstrated, nor were any trends discernible. Findings were the same for acute and myeloid forms of leukemia. The minimum population size required to demonstrate a leukemogenic effect of background radiation under conditions prevailing in northern New England was also computed on the basis of available radiogeological data. The number of person-years available to the study (50 million) was found to be sufficient to test only the upper limit of the possible range of dose-effect relation. The results suggest that terrestrial background radiation is not measurably leukemogenic at the dose rates operative in northern New England. The minimum population size necessary to demonstrate a leukemogenic effect of background radiation was also computed under conditions assumed to prevail in Kerala. Various aspects of leukemogenes due to diagnostic radiation are also discussed. It was concluded that probably not more than 5% of leukemia can be attributed to radiotherapy. At most, 10% of leukemia in children under 10 yr of age can be attributed to prenatal x-ray exposure; postnatal exposure seems to be even less significant. (P.C.H.)

14018 INDUCTION BY RADIATION OF LEUKEMIAS AND OTHER MALIGNANT DISEASES OF HEMATOPOIETIC CELLS IN EXPERIMENTAL ANIMALS. R. H. Mole (Medical Research Council Radiobiological Research Unit, Harwell, Berks, Eng.). Bull. World Health Organ., 26: 613-18 (1962).

A review is presented on mice leukomogenesis. Mice of all strains are generally susceptible to leukemia induction by radiation and nearly all experimental work is carried out on these species. The same kinds of leukemia can also be produced in rats, but the Chincse hamster is strikingly more resistant to leukemogenesis by radiation than the mouse. The classical murine leukemia is thymoma or mediastinal lymphosarcoma. Sufficient irradiation is followed by a high incidence (80 to 100%) of the mediastinal tumor. Single doses of radiation are leukemogenic, although it is rarely possible to raise the leukemia incidence beyond 30%. The frequency of leukemia often increases with dose up to a certain level of dose and then decreases with further increase in dose. In appropriate circumstances almost every mouse can become leukemic. (P.C.H.)

14019 BONE MARROW GRAFTS AFTER TOTAL-BODY IRRADIATION OF LEUKEMIC MICE FOLLOWING THE ADMINISTRATION OF AN ANTIMITOTIC AGENT. G. Mathé, J. L. Amiel, and J. L. Niemetz (Hôpital Saint Louis, Paris). Bull. World Health Organ., 26: 692-5(1962). (In French)

Attempts were made to determine whether pretreatment of irradiated, marrow-injected leukemic mice has a life-prolonging effect. L 1210 leukemic cells, originally obtained from DBA/2 mice, were injected subcutaneously in F_1 hybrid mice (C57B16 × DBA/2). The mean survival time of the mice (11.0 days) was prolonged by treatment with the antimitotic agents amethopterin (21 days) and cyclophosphamide (15.5 days). Whole-body 850-rad x irradiation of the untreated leukemic mice slightly prolonged survival time (14.4 days), and this time was further prolonged by an injection of isologous (C57B16) bone marrow cells (22.6 days). Pretreatment of mice with the chemical agents, before irradiation and marrow replacement, significantly enhanced survival time. The effect was more pronounced with amethopterin (26.5 days) than cyclophosphamide (23.1 days). By combined use of marrow grafts and the antimitotic drugs it was possible to obtain prolonged survival (>70 days) of 9 out of 111 irradiated, leukemic mice. (H.H.D.)

14020 MORTALITY FROM CANCER IN AN AREA OF HIGH BACKGROUND RADIATION. L. Gianferrari, A. Serra, G. Morganti, V. Gualandri, and A. Bonino (Uni-

ve ità, Milan, Italy). Bull. World Health Organ., 26: 696-7(1962).

A survey was made of births, deaths, and other relevant variables in some communities in the Cervo Valley (Province of Vercelli, Piedmont, Italy), where the background radiation level is higher than normal (HBR area), and in a near by area, which is geographically, socially, and economically similar to the first, except there is a normal level of background radiation (NBR area). In the NBR area the average total dose of γ radiation from the external environment approximates that which most populations are ordinarily exposed to, 3 r per 30 years. In the HBR area the dose was 5 times greater. The average yearly exposure doses in the NBR and HBR areas, respectively, were estimated to be 147 and 552 Mr. The average uranium content (as U_3O_8) in various alimentary sources in the respective areas was: soil 1.0, 20.8 mg/kg; drinking water 0.06, 0.24 μg/l; vegetables 0.3, 17.7 mg/kg; and fodder 0.4, 18.4 mg/kg. In the HBR area the observed proportion of deaths from cancer was higher than the expected one in every age group; however, the increase was significant only in the 61- to 80-yr age group. The findings suggest that the observed difference in mortality from cancer might be associated with the difference in internal and external radiation, and that the consequences become more evident between 60 and 80 years of age. (P.C.H.)

14021 A STUDY OF THE PROTECTIVE ACTION OF SEROTONIN (5-HYDROXYTRYPTAMINE) AGAINST WHOLE-BODY X-IRRADIATION IN MICE WITH THE AID OF CHROMIUM 51. P. V. Vittorio, E. W. Wright, and B. E. Sinnott (Defence Research Board, Kingston, Ont.). Can. J. Biochem. Physiol., 41: 347-60(Feb. 1963).

Studies were carried out to determine the effect of x radiation on the uptake of Cr^{51} in different organs in the mouse. Experiments were also carried out to determine whether the initial radiation effect, if any, was lessened or the return to normal Cr^{51} uptake accelerated when the animal was treated with a specific radioprotective agent (serotonin) prior to exposure to x radiation. If the assumption is made that early disturbances in Cr^{51} content in different organs are a measure of the effect of various treatments and the return to normal Cr^{51} content a measure of recovery, the results obtained could be indicative of changes caused by x irradiation and those prevented or caused by serotonin. (auth)

14022 THE DISTRIBUTION AND THE CHEMICAL FORMS OF THE RADIATION-PROTECTIVE AGENT AET IN MAMMARY TUMOR-BEARING MICE. Bernard Shapiro, Emanual E. Schwartz, and George Kollmann (Albert Einstein Medical Center, Philadelphia). Cancer Res., 23: 223-8(Feb. 1963).

The distribution and the chemical nature of AET in the various tissues of C57BL/6J male tumor-bearing mice given a protective dose of either of two forms of the radiation-protective agent S-(2-aminoethyl)thiuronium bromide hydrobromide were studied. The mice carried a subcutaneously transplanted mammary adenocarcinoma. Results at 20 min after an intraperitoneal (IP) injection of 140 or 280 mg/kg 2-mercaptoethylguanidine (MEG) and at 20 or 120 min after an IP injection of 140 mg/kg bis(2-guanidoethyl) disulfide (GED) were obtained. At 20 min the tumor took up less protective agent than did most of the vital organs except brain. The tumor contained the same S^{35}-labeled chemical compounds that normal tissues contained. The concentration of GED in the tumor was the only form which correlated with protection of the tumor against the effects of local irradiation. As compared with normal animals, tumor-bearing animals appeared to have difficulty excreting the protective agent. It is suggested that the optimum conditions for protecting normal tissues without protecting tumor in these animals are IP injections of large doses of MEG at 20 min before irradiation. (auth)

14023 SPINDLE DISAPPEARANCE AND CHROMOSOME BEHAVIOR AFTER PARTIAL-EMBRYO IRRADIATION IN CECIDOMYIIDAE (DIPTERA). Irene Geyer-Duszyńska (Univ. of Chicago). Chromosoma, 12: 233-47 (1961).

Embryos of Rhabdophaga batatas Walsh were irradiated. It was established that in this species 2 S + E = 40 and 2 S (for female) = 8. Embryos were irradiated with 8 μ and 16 μ heterochromatic ultraviolet microbeams not only in this fifth cleavage but also in the fourth, in which elimination was never observed. The irradiated regions were small parts of somatic cytoplasm or small parts of germ cells. The effects of irradiation were multifold: complete degeneration of nuclei in the vicinity of irradiated cytoplasm; disappearance of spindle and formation of quasi-rosettes; multipolar mitosis. The polar substance present in germ cells was often severely damaged and fragmented. All the effects were evidently indirect. The results show that elimination of E chromosomes does not result from failures in chromosomal spindle fibers or from intrinsic morphological defects in the centromeres. The fact that elimination can be suppressed by indirect action of ultraviolet light strongly supports the assumption that elimination occurs because of chemical changes in adjacent cytoplasm that are injurious to the centromeres of E chromosomes. Most probably the indirect action of ultraviolet interferes with the production of some substance that is normally injurious to the centromeres in the fifth division. (P.C.H.)

14024 COMPARATIVE REACTIVITY OF RADIOPROTECTIVE SULFIDE COMPOUNDS WITH DIPHENYLPICRYLHYDRAZYL. André Cier, Claude Nofre, and René Écalle (Centre de Recherches du Service de Santé des Armées, Lyon). Compt. Rend., 255: 2840-2(Nov. 19, 1962). (In French)

The reaction velocities of 22 sulfide derivatives with diphenylpicrylhydrazyl were compared. There exists a satisfactory correlation between the reactivity of these derivatives with respect to the free organic radical and their radioprotective power in mammals. (tr-auth)

14025 IN VITRO ISOTYPIC INTERFERENCE BY ROUS VIRUS INACTIVATED BY X RAYS. Raymond Latarjet and Alice Goldé. Compt. Rend., 255: 2846-8(Nov. 19, 1962). (In French)

Rous virus, inactivated by x rays under conditions where the indirect effects predominate, can inhibit up to 99% the production of active virus by infected cellular cultures. No interference was obtained with the virus inactivated by the direct effect of x rays. (tr-auth)

14026 THE ATTENUATION OF LATENT LESIONS CAUSED BY THE ACTION OF X RAYS ON RHIZOMES OF TOPINAMBOUR. Robert Jonard. Compt. Rend., 3031-3 (Nov. 26, 1962). (In French)

Tests on in vitro cultures of isolated rhizome fragments of Topinambour after x irradiation show that the changes caused by the irradiation can regress if the cultivation of the tissues is made several weeks after irradiation. (tr-auth)

14027 HEMATOPOIETIC RESTORATION OF IRRADIATED MICE BY GRAFT OF ALLOGENIC BONE MARROW OF SEVERAL DONORS OF DIVERSE LINES. Georges Mathé, Jean-Louis Amiel, Michio Matsukura, and Anne-

Marie Méry (Hôpital Saint-Louis, Paris). Compt. Rend., 255: 3480-2(Dec. 17, 1962). (In French)

The restoration of mice irradiated with a lethal dose can be assured by a mixture of hematopoietic cells of several donors of diverse lines. The frequency of secondary syndromes is low. The study, by skin grafts, of the immunitary tolerance connected to chimerism shows the selection by the receivers of the closest genetic hematopoietic grafts. (tr-auth)

14028 DAMAGE TO THE HUMAN ORGANISM BY RADIOACTIVE ISOTOPES. Jan Wozniak. Farm. Polska, 18: 472-5(Oct. 10, 1962).

A review is given on: fallout from nuclear testing; I^{131} and P^{32} in medical diagnosis; chemical and biological half life concepts; need for differentiating toxic from actinic effects; particle size and solubility; radiocolloids; phagocytosis; role of protein binding and complex formation both in pathogenesis and therapy; and accumulation of Po in inflammatory foci. (P.C.H.)

14029 CHANGES IN THE ACTIVITY OF THE CENTRAL NERVOUS SYSTEM IN THE OFFSPRING OF IRRADIATED RATS. M. S. Alekseeva (Pavlov Inst. of Physiology, Academy of Sciences, USSR). Federation Proc., Transl. Suppl., 22: No. 1, Pt. II, T-34-6(Jan.-Feb. 1963).

Some offspring of rats mated after exposure to low doses of ionizing radiation exhibited changes in central nervous activity, manifested in reduced mobility of the nervous processes, intensified specialized subcortical reflexes, and development of spontaneous epileptoid seizures. The decrease in mobility of the nervous processes was more pronounced in the rats with the seizures. (auth)

14030 DYNAMICS OF ARTERIAL PRESSURE IN TOTAL-BODY IRRADIATION OF RATS. I. S. Kanfor. Federation Proc., Transl. Suppl., 22: No. 1, Pt. II, T69-70(Jan.-Feb. 1963).

The magnitude of the level of the systolic pressure and also the degree of contractility and tone of the blood vessels are important indexes of the severity of the course of radiation sickness, and they facilitate, along with the present indexes, the determination of the closest prognosis of this sickness in white rats. Maintenance of the systolic pressure at a level exceeding 50 to 60 mm, and also of the tonic response of the vascular tone and contractility, together with other data, indicate a favorable course of radiation sickness. (auth)

14031 ELEVATION OF OXYGEN CONSUMPTION IN RATS DURING IRRADIATION. A. Vacek (Inst. of Biophysics, Czechoslovak Academy of Sciences). Federation Proc., Transl. Suppl., 22: No. 1, Pt. II, T96-7(Jan.-Feb. 1963).

The influence of the central and peripheral nervous systems on the rise in metabolic activity developing in response to x rays was investigated. The experimental animals used included 80 rats and 50 rabbits. The rats were divided into three groups: the first group received only total-body irradiation, the second received total-body irradiation after transection of the spinal cord, and the third received total-body irradiation after spinal cord transection and crushing of the part of the cord lying below the level of transection. The rabbits were separated into 5 groups of 10 animals each: the first group received total-body irradiation; the second received radiation to the head, with the body shielded; the third received radiation to the body with the head shielded; the fourth received total-body irradiation while in a state of electronarcosis; and the fifth group was studied in a state of electronarcosis without irradiation. Oxygen consumption was measured in a chamber through which air was passed, and was referred to unit body weight. Oxygen consumption of the first group of rabbits increased gradually throughout the period of radiation exposure. Irradiation of the head alone did not produce a rise in oxygen consumption, but exposure of the body resulted in a statistically significant increase in oxygen consumption. Oxygen consumption also increased in rabbits irradiated under electronarcosis, reaching a maximum in the first 3 to 4 min, whereas the maximum was not reached until after 8 or 9 min in the case of rabbits exposed without electronarcosis. In rats, oxygen consumption increased among antimals of the first group; but after spinal cord transection no increase in response to irradiation was observed. These results indicate that irradiation enhances metabolic processes, shown by an increase in oxygen consumption, even while exposure is taking place. It is concluded that a reflex mechanism underlies the rise in oxygen consumption. Experiments with irradiation of the head show that the central nervous system does not play a direct part in the elevation of oxygen consumption during irradiation. The presence of an intact spinal cord likewise is not sufficient to bring about such a rise in total-body irradiation experiments even when spinal reflexes have recovered. It is postulated that physicochemical changes develop in tissues during exposure to ionizing radiation and affect peripheral receptors either directly or through disturbances in metabolic processes. (C.H.)

14032 ASCORBIC ACID EXCHANGE DURING THE ACTION OF X-RAYS ON THE ORGANISM. Z. Ya. Dolgova. Federation Proc., Transl. Suppl., 22: No. 1, Pt. II, T130-31(Jan.-Feb. 1963).

The guinea pig, following acute radiation injury, develops a vitamin deficiency condition which is manifested by vitamin C impoverishment of a number of organs. Single dose, whole-body irradiation of guinea pigs by roentgen rays in a 600-r dose lead to a decrease in the ascorbic acid level in the tissues of the brain, adrenals, testes, spleen, and small intestine, which indicates impairment of the metabolic processes in the irradiated animals. The greatest changes in the vitamin C level following acute radiation injury were observed in the neuroendocrine and blood systems. The ascorbic acid content in the whole blood of the irradiated guinea pigs was reduced, particularly in the period 3rd to 7th days following irradiation. The capacity of ascorbic acid absorption by the blood proteins increased as a result of irradiation, and this indicates a decrease in the vitamin saturation of the organism. Analysis of the data obtained indicates that in the irradiated guinea pig, the organism's need for ascorbic acid increases. (auth)

14033 FUNCTIONAL CHANGES IN THE THYROID AS A GENERAL IRRADIATION REACTION FOLLOWING TREATMENT OF PATIENTS WITH CANCER OF THE CERVIX. N. A. Pisareva. Federation Proc., Transl. Suppl., 22: No. 1, Pt. II, T150-1(Jan.-Feb. 1963).

Study of the functional state of the thyroid gland by means of I^{131} demonstrated a distinct percentage increase of the accumulation of this isotope at the peak of the general radiation reaction in 39 out of 67 patients with cancer of the cervix who were subjected to curie roentgen therapy. In 28 patients, in whom menopause had developed, several years prior to discovery of the cervical cancer and application of irradiation therapy, the function of the thyroid gland was not changed in comparison with the average functional indexes of healthy women of the corresponding age. (auth)

14034 LONG-TERM OBSERVATIONS OF PERSONS RECEIVING RADIOTHERAPY. M. P. Domshlak, Yu. G.

Grigoriev, N. G. Darenskaya, L. B. Koznova, G. F. Nevskaya, V. I. Nesterova, and N. Ya. Tereschenko. Federation Proc., Transl. Suppl., 22: No. 1, Pt. II, T152-5 (Jan.-Feb. 1963).

Results are summarized from an examination of 218 persons 30 to 60 years of age at periods up to 10 years after exposure to therapeutic doses of x or γ radiation. The courses of radiotherapy involved both whole-body and local irradiation of the head, chest, and abdomen. Single doses of the order of 25 to 50 r and total doses from 100 to 400 r were used in whole-body irradiation and local irradiation of 200 to 300 r single dose and 5,000 to 15,000 r total dose over a period of 1 to 3 mo were administered. Irradiation was carried out either for malignant neoplasms or for prophylactic purposes after removal of tumors. The examination showed that a deterioration occurred in 41.9% of the cases. The most general complaints were general asthenia, increased fatigue, dyspnea, tachycardia, and pains in the heart region. Morphogenic changes in leukocytes induced by radiation were retained for a long time. A decrease was noted in resistance to common colds. Changes in the nervous system were detected in 65 persons. A distinct relation was observed between the severity of the neurologic syndromes and the time periods that had passed after irradiation. (C.H.)

14035 A SIMPLE METHOD OF ULTRAVIOLET MICROBEAM IRRADIATION OF ORGANELLES OF LIVING CELLS. A. P. Dubrov (Inst. of Biophysics, Academy of Sciences, Moscow). Federation Proc., Transl. Suppl., 22: No. 1, Pt. II, T172-3(Jan.-Feb. 1963).

An optical scheme is described for use in ultraviolet-microbeam irradiation of living cells and tissues. (C.H.)

14036 A SEARCH FOR HISTOCOMPATIBILITY DIFFERENCES BETWEEN IRRADIATED SUBLINES OF INBRED MICE. J. Godfrey and A. G. Searle (Medical Research Council, Harwell, Berks, Eng.). Genet. Res., 4: 21-9(Feb. 1963).

A tail-skin grafting method was used to test for histocompatibility differences between members of thirteen sublines of C_3H inbred mice, kept in a 1 r/night gamma radiation field for twelve generations, on the average, and separated from each other by about thirty-four generations. No homograft rejections occurred, so there was no evidence to suggest that mutations at histocompatibility loci had taken place in any of these sublines. Calculations show that this finding does not conflict with the idea that a fairly large number of loci are involved, having mutation rates similar to those already known in the mouse. (auth)

14037 SEMI-QUANTITATIVE RELATIONSHIP OF RADIATION AND NEOPLASIA IN MAN. Victor E. Archer (Public Health Service, Salt Lake City) and C. Lenore Simpson. Health Phys., 9: 45-56(Jan. 1963).

The hypothesis that a linear relationship exists between dose and induction of neoplasms is supported by data for humans. Under this hypothesis, g rad dosages to groups of individuals who have been followed, is used to calculate various neoplastic doses. Infants are shown to be more prone to radiation-induced neoplasms than adults. It may be concluded that even though there are uncertainties in the data and in the hypothesis, the conservative approach to the irradiation of man will utilize these figures until the basic assumptions are disproved, or until more precise figures become available. (auth)

14038 CHROMOSOME ABERRATIONS INDUCED BY IONIZING RADIATIONS. H. J. Evans (Medical Research Council Radiobiological Research Univ., Harwell, Berks, Eng. and Brookhaven National Lab., Upton, N. Y.). Intern. Rev. Cytol., 13: 221-321(1962). (BNL-5659)

Reaction mechanisms involved in the induction of chromosome aberrations by ionizing radiation are reviewed. Topics discussed include chromosome and chromated type aberrations; the exchange hypothesis; chromosome stickiness and sub-chromated aberrations; the relation between aberration structure and the mitotic and meiotic cycles; the relative radiosensitivity of different organisms, cell types, and stages in cell development; factors affecting the distribution of aberrations within and between nuclei and chromosomes; the oxygen effect in aberration production; physical and chemical factors modifying aberration frequencies, and the relative efficiencies of different ionizing radiations in the production of chromosome aberrations. (C.H.)

14039 WHOLE ORGAN GRAFTS OF THE STOMACH. Richard C. Lillehei, Jerrold K. Longerbeam, and William R. Scott (Univ. of Minnesota, Minneapolis). J. Am. Med. Assoc., 183: 861-5(Mar. 9, 1963).

Autografts of the whole stomach of dogs have functioned normally up to 3 yr following surgery even when the stomach has been held in vitro for up to 5 hr before replantation. Such replanted stomachs take several months to regain the ability to secrete normal amounts of free acid in response to histamine. In all dogs followed up to 3 yr, so far, the ability of the replanted stomach to secrete pepsin in response to pilocarpine has remained negligible. Dogs with replanted stomachs are resistant to the ulcer-provoking effects of chronic histamine in beeswax injection. Four thousand or 5,000 r γ radiation, delivered to the stomach in vitro before replantation appears to destroy almost all of the parenchymal cells of the gastric mucosa. (auth)

14040 THE INFLUENCE OF X RAYS ON ORGANELLE INDUCTION AND DIFFERENTIATION IN GRASSHOPPER SPERMATOGENESIS. T. N. Tahmisian and R. L. Devine (Argonne National Lab., Ill.). J. Biophys. Biochem. Cytol., 9: 29-45(Jan. 1961).

The effects of x radiation on grasshopper spermatogenesis were studied by light and electron microscopy. The insects were irradiated at the second instar prior to the presence of maturation stages and observed at the last instar and imago stages. Dosages of 100 to 600 r retarded the differentiation of the nucleus and mitochondrial nebenkern in spermatids. Irradiation caused a curtailment and disorganization in the differentiation of the nebenkern from mitochondria. It also induced the formation of supernumerary centrioles, flagellar filaments, and acrosomes; nuclear disorganization as well as pycnosis and fragmentation also occurred. The nucleus appeared to be drawn toward each radioinduced supernumerary acrosome, with consequent multipolarity of the nucleus. Induction of a set of flagellar filaments was seen only where the centriolar structure was in contact with the nucleus. Details are given of an organelle that is composed of anastomosed and interwoven cytoplasmic strands. The results show that radioinduced changes in cell morphology are preceded by either alteration or curtailment of organelle differentiation. Furthermore, organelle differentiation during spermatogenesis was altered by doses that did not visibly affect the antecedent mitotic, maturation, or meiotic divisions; grasshoppers irradiated during the third instar showed the first effects of radiation at the last instar. (P.C.H.)

14041 OPTICAL AND ELECTRON MICROSCOPIC CHANGES IN ULTRAVIOLET-IRRADIATED CHROMOSOME SEGMENTS. William Bloom and Robert J. Leider (Univ. of Chicago). J. Cell Biol., 13: 269-301(1962).

Chromosome segments of urodele cells lose some substance after irradiation with about 10^{-1} ergs/μ^2 of heterochromatic ultraviolet light. The segments stain faintly or negatively with the Feulgen and pyronine- methyl-green methods and weakly with the Alfert-Geschwind stain for basic protein. This suggests that DNA may be changed or lost at the site of irradiation. In such cells, fixed in neutral formalin in Tyrode's solution and stained with phosphotungstic acid, electron microscopy shows that the unirradiated parts of the chromosomes consist of a homogeneous or finely fibrillar material (component-A) filling the meshes of an irregular network with bars 40 to 300 A in diameter, some of which continue into a similar interchromosomal network. DNA-steretic portions of the chromosomes consist mainly of this network and only small amounts of component-A, which presumably contains the DNA. DNA-steresis was not demonstrated with the electron microscope after primary fixation with OsO_4 or $KMnO_4$. Structural changes due to DNA-steresis were compared with certain nuclear changes in the mitotic cycle. (P.C.H.)

14042 THE NATURE AND RADIATION SENSITIVITY OF THE LONG FORMS OF ESCHERICHIA COLI STRAIN B/r. R. J. Munson and F. I. MacLean (Medical Research Council, Harwell, Berks, Eng.). J. Gen. Microbiol., 25: 29-39(May 1961).

From studies of x-ray survival and of the number and disposition of nuclear bodies and cell membranes, the nature of long forms of E. coli strain B/r and the effect of radiation on their division processes were investigated. X-ray survival data indicated that radiosensitive sites were distributed along the length of an organism at intervals of 1-1.5 μ, while nuclear staining by the HCl-Giemsa method showed chromatinic bodies at an average spacing of 1.2 μ. Thus each nuclear body appeared to be a radiosensitive site. The proportion of cells able to form colonies on minimal agar after x radiation was a function of the dose and the average cell length. For the shortest cells the survival curve is almost exponential. By drawing smooth curves through the experimental points the doses of x radiation for any degree of survival (or killing) can be found. The ratio of the doses for 90 and 50% killing, namely, LD_{90}/LD_{50}, depended mainly upon the average cell length and was independent of the cultural conditions. Lysozyme treatment did not reveal evidence of transverse membranes apart from those at visible constrictions. It was concluded that the longer organisms arose by the inhibition of the terminal stages of division. (P.C.H.)

14043 ANTIBODY RESPONSES INDUCED BY AQUEOUS AND EMULSIFIED INFLUENZA VIRUS VACCINES IN MICE EXPOSED DAILY TO X RAYS. Bryon S. Berlin (Univ. of Michigan, Ann Arbor). J. Immunol., 89: 906-9 (Dec. 1962).

Hemagglutination-inhibiting (HI) antibody responses to aqueous and emulsified mineral oil adjuvant influenza virus vaccines were compared at 15, 27, and 43 days after vaccination in mice exposed daily to x radiation beginning 1 day before vaccination. A daily dose of 75 r was selected. By the 15th day after vaccination, 450 r given as 6 exposures and 900 r given as 12 exposures caused 1 death among 33 mice and 4 deaths among 32 mice, respectively. Cumulative exposure to 450 and 900 r given as 12 or 24 exposures to 37.5 r/day did not cause deaths, but were probably near the lethal range. By the 43rd day after vaccination, 510, 1020, and 1530 r given as 34 exposures to 15, 30, and 45 r, respectively, had the same lethal effect as 450 and 900 r at 15 days. At each bleeding, HI levels induced by the adjuvant were higher in similarly irradiated mice than those induced by an aqueous vaccine containing the same amount of antigen. Moreover, HI responses in the irradiated mice injected with emulsified vaccine were equal or higher at each bleeding than those in mice injected with aqueous vaccine but not irradiated. The findings were interpreted as indicating that the adjuvant effect of emulsified vaccine was reduced, but not abolished, by repeated exposure to x rays. (P.C.H.)

14044 A CASE OF PERICHONDRITIS AND NECROSIS OF LARYNGEAL CARTILAGE 25 YEARS AFTER TREATMENT WITH RADIUM. F. C. Robson and J. D. K. Dawes. J. Laryngol Otol., 75: 997-8(Nov. 1961).

The history and treatment of a case is described. (H.H.D.)

14045 CHANGES INDUCED IN THE RAT CENTRAL NERVOUS SYSTEM FOLLOWING CUMULATIVE EXPOSURE TO X IRRADIATION: A SHORT TERM STUDY. Robert H. Brownson (Medical Coll. of Virginia, Richmond). J. Neuropathol. Exptl. Neurol., 20: 206-18(Apr. 1961).

Rats were exposed to total-head x irradiation in doses of 1000 r/week until the accumulated doses ranged from 1000 to 5000 r. During the short interval following each exposure, animals at all dosage levels demonstrated behavioral changes and subsequent weight loss. Neurons in the cerebral cortex, brain stem, and cerebellum demonstrated slight to severe alterations at all dosage levels. Generally, cell changes became more numerous and severe with increasing accumulative doses and time following exposure. Neuroglial cells were only slightly affected. Astrocytes were observed in occasional areas of cellular gliosis. The choroid plexus, ependymal, and subependymal cells underwent variable changes in structure. Greater evidence of swelling and vacuolization were noted at lower levels of irradiation. In the higher accumulated dose levels cell shrinkage and pyknosis were prevalent. Areas of meningeal thickening were noted at all dosage levels, becoming most evident at the accumulated levels of 4000 and 5000 r. Occasional endothelial cell hypertrophy and hyperplasia were also noted in capillaries and small arteries. (P.C.H.)

14046 POTENTIAL ANTIRADIATION AGENTS. I. β-THIOETHYLAMINO DERIVATIVES OF NUCLEIC ACID CONSTITUENTS. Shih-Hsi Chu and Henry G. Mautner (Yale Univ., New Haven). J. Org. Chem., 26: 4498-4501 (Nov. 1961).

In attempts to increase the specificity of thiol agents and protect the genetic material of the cell, which is very sensitive to radiation damage, the synthesis of a group of compounds was undertaken in which cysteamine is attached through its amino group to a series of purine and pyrimidine components of nucleic acids. The 5-position of pyrimidines and the 8-position of purines seem well suited for the attachment of groups to be introduced into nucleic acids. Attempts were also made to introduce the bis(β-thioethyl) amino group into suitable carrier molecules to yield double-armed cysteamines. While attempts to isolate bis-(β-mercaptoethyl)amine were unsuccessful, the oxidized form of the compound, 1,2-dithia-5-azepane was prepared in good yield. Thus, the preparation of N-substituted 1,2-dithia-5-azepanes appeared feasible. A number of uracilyl compounds were prepared by reaction sequences which are shown. β-Benzylthioethylamine, prepared by the reaction of ethyleneimine with α-toluenethiol, was found to react with 5-bromouracil to yield 5-(β-benzylthioethylamino) uracil. This compound could also be obtained by the addition of α-toluenethiol to 5-(β-chloroethylamino)uracil (one-armed uracil mustard). Debenzylation with sodium in liquid ammonia resulted in the formation of 5-(β-mercap-

toethylamino)uracil. Attempts to isolate the compound were unsuccessful; however, oxidation readily yielded its disulfide form. Bis(β-benzylthioethyl)amine reacted with 5-bromouracil to form 5-bis(β-benzylthioethylamino)uracil. An alternative synthesis of the compound involved the addition of the sodium salt of benzyl mercaptan to 5-bis(β-chloroethylamino)uracil (uracil mustard). Reduction of the bis-benzylthio compound with sodium in liquid ammonia followed by air oxidation yielded N-(5-uracilyl)-1,2-dithia-5-azepane. N,N'-bis(8-adeninyl)cystamine was prepared in analogous fashion from 8-(β-benzylthioethylamino)adenine, which in turn was obtained by the reaction of 8-bromoadenine with β-benzylthioethylamine. Difficulties were encountered in isolating mercaptans as such because of the rapidity of air oxidation. (P.C.H.)

14047 POTENTIAL ANTIRADIATION AGENTS. II. SELENIUM ANALOGS OF 2-AMINOETHYLISOTHIOURONIUM HYDROBROMIDE AND RELATED COMPOUNDS. Shih-Hsi Chu and Henry G. Mautner (Yale Univ., New Haven). J. Org. Chem., 27: 2899-2900(Aug. 1962).

In view of the effectiveness of aminoethyl mercaptan (cysteamine) and of 2-aminoethylisothiouronium (AET) salts in protecting animals against ionizing radiation, efforts were made to prepare even more active analogs of the compounds. Sulfur is considered to be essential to the radioprotective action of cysteamine analogs; however, the selenium analog of cysteamine can shield mice against radiation. Since the atomic radii of sulfur and of selenium are similar, sulfur and selenium analogs may be assumed to have the same ability of fit receptor sites. The selenium analog of AET was prepared by the reaction of selenourea with 2-bromoethylamine hydrobromide. Treatment of the selenouronium salt with NaOH yielded 2-selenoethylguanidine, which was isolated as the flavianate salt. The reaction of 2-aminoethylisoselenouronium hydrobromide with boiling water resulted in the formation of 2-aminoselenazoline. Through the reaction of 2-methylaminoethyl, 2-dimethylaminoethyl, and 2-diethylaminoethyl halides with selenourea the corresponding 2-alkylaminoethyl selenouronium salts were obtained. Similarly, 3-aminopropylisoselenouronium hydrobromide was synthesized. (P.C.H.)

14048 SOME RESULTS OF ELABORATION OF THE PROBLEM OF RADIOBIOLOGY IN PUBLIC HEALTH INSTITUTIONS FOR 1961. E. I. Vorobev and L. V. Funshtein (Central Research Inst. of Medical Radiology, Ministry of Health, USSR). Med. Radiol., 8: No. 1, 38-44(Jan. 1963). (In Russian)

Discussion is given on results of scientific research in 1961 in the field of radiobiology carried out in institutions of the USSR Public Health. Bone marrow transplantation became a prominent feature in the treatment of radiation sickness. Some tests were recommended for the detection of acute radiation sickness and certain manifestations of radiation affection in experiments and in patients who had undergone radium therapy are described. Studies of the remote sequelae of radiation influence divulged a diminution of antitumor resistance, the development of anemia, irreversible changes of blood cells, and impaired reaction of the suprarenals to ACTH. Investigations of the diverse aspects of pathogenesis of radiation sickness ranged foremost among the works on radiobiology. Shortcomings in the elaboration of the problem of radiobiology, particularly ideas of cybernetics, which found no support, are noted. (P.C.H.)

14049 THE INFLUENCE OF LONG-TERM INTERNAL IRRADIATION WITH LOW DOSES OF RADIOACTIVE ZINC ON THE BIOELECTRIC ACTIVITY OF THE BRAIN IN RABBITS. V. G. Ovakimov. Med. Radiol., 8: No. 1, 45-6 (Jan. 1963). (In Russian)

A prolonged introduction to rabbits of low doses of radioactive zinc (10 microcuries/kg) leading up to the development of chronic radiation sickness did not produce any essential changes in the spontaneous bioelectric activity of the brain. At early dates of the intoxication (up to 3 months) some alterations of the electrocorticogram reactions to rhythmic photostimulation were seen, manifesting themselves in the broadening of the direction range to the right (registration of the rhythm rate imposed on the higher stimulation frequencies). (auth)

14050 NICOTINIC ACID METABOLISM IN THE IRRADIATED ORGANISM. V. P. Kalashnikova (Inst. of Nutrition, Academy of Medical Sciences, USSR). Med. Radiol., 8: No. 1, 58-61(Jan. 1963). (In Russian)

The causes of decreased excretion of N^1-methylnicotinamide (N^1MNA) with the daily urine in rats subjected to a single x irradiation in a dose of 600 r were studied. It was disclosed that the reduced N^1MNA excretion with the daily urine in irradiated rats was not associated with a diminished food intake. Simultaneously with a drop of N^1MNA excretion with the urine in irradiated rats there was observed a disturbance of biosynthesis of nicotinic acid from tryptophan, as well as a diminished content and intensity of biosynthesis of diphosphopyridinenucleotide in the liver. The cited changes point to the possibility of development of nicotinic acid deficiency in the irradiated organism. (auth)

14051 EFFECTS OF IONIZING RADIATIONS IN FRACTIONATED DOSES ON THE PHAGOCYTIC ACTIVITY OF THE RETICULO-ENDOTHELIAL SYSTEM (R.E.S.). L. Bolis, F. Bellini, and M. Magistretti (Università, Milan). Minerva Nucl., 6: 318-21(Oct. 1962). (In Italian)

The effects of fractional doses of ionizing radiations on the phagocytic activity of the R.E.S. were investigated. Insignificant variations of α and the sedimentation rate were observed up to the 21st day of irradiation in rats irradiated with 100 r; this was followed by a 12 to 15% increase in the values due to slight stimulation of the R.E.S. In rats irradiated with 250 r, a significant decrease in the phagocytic activity of the R.E.S., revealed by a marked reduction of the values for α and the sedimentation rate, was observed. With the fractional irradiation technique, the successive variations in the phagocytic activity of the R.E.S. could be followed; it was shown that maximal inhibition occurs during the first week after the last dose, and that during the second week normal values are restored, whereas increased values are present after 30 days. (auth)

14052 DECREASED INCORPORATION OF PHOSPHORUS-32 IN RADIOSENSITIVE ORGANS AFTER WHOLE-BODY IRRADIATION IN RATS. Z. Dienstbier and F. Vítek (Charles Univ., Prague). Nature, 197: 198-9(Jan. 12, 1963).

The incorporation of P-32 into the radiosensitive organs of irradiated animals is significantly smaller during the 14-day investigatory period than in the case of nonirradiated animals. The degree of uptake of P-32 in the compact bone is greater during the entire period of investigation in the irradiated animals. The level of P-32 in the blood is significantly higher the first day after the irradiation and increases substantially from the seventh day. (H.G.G.)

14053 INFLUENCE OF EXCESS OF ANTIGEN ON IMMUNOLOGICAL TOLERANCE IN RADIATION CHIMAERAS. O. B. Zaalberg, W. W. H. Weyzen, and O. Vos (National Defence Research Organization TNO, Rijswijk (Z. H.), Netherlands). Nature, 197: 300-1(Jan. 19, 1963).

When the lymphatic system of an irradiated allogenic animal is repopulated with cells from normal bone marrow, tolerance may only develop if sufficient antigens are present. Transplantation of even a small number of normal lymph node cells always results in an immunological graft versus host reaction and a "killing effect" of the host. Transfer of bone marrow from a tolerant chimaera to an irradiated animal in which the specific antigens are absent results in a loss of this tolerance, and when excess of another antigen is present, tolerance to this antigen may develop. A factor that determines the success of the transfer of tolerance is the dose of lymph node cells. Their number should be far in excess of the bone marrow cell dose. A competition to repopulate the lymphatic tissue seems to exist between bone marrow and lymphoid cells. These results indicate that mouse bone marrow is a source of cells with undetermined immunological function. These cells can develop into immunologically active lymphoid cells or into tolerant lymphoid cells when an antigen excess is present. (H.G.G.)

14054 GENETIC EFFECTS OF STRONTIUM-90 INJECTED INTO MALE MICE. K. G. Luening, H. Froelen, A. Nelson, and C. Roennbaeck (Research Inst. of National Defence, Sundbyberg, Sweden). Nature, 197: 304-5(Jan. 19, 1963).

The genetic effects of strontium-90 and cesium-137 injected into male mice were compared. Injections with cesium-137 had no demonstrable effect as regards intra-uterine death. The strontium-90 injections show a marked increase in intra-uterine deaths compared with its control and reaches a peak in the third week after injection, but approaches the control during the fifth week. This indicates that strontium ions penetrate the sperm and exchange with calcium ions. (H.G.G.)

14055 PROTEIN NUTRITION AND RADIATION DAMAGE IN MICE. Seiei Tanaka (Tokyo Metropolitan Isotope Centre), Atsushi Nukasawa, Haruhisa Yoshikawa, and Yoshimasa Yoneyama. Nature, 197: 305-6(Jan. 19, 1963).

Protein diet after, as well as before, irradiation had a pronounced favorable influence on the mortality of whole-body irradiated mice, an excessive supplement of protein after radiation produced unfavorable effects. High susceptibility of protein-depleted rats to whole-body x irradiation was seen. (H.G.G.)

14056 ALTERATIONS IN SKELETAL MUSCLE AFTER X-IRRADIATION AND THEIR SIMILARITY TO CHANGES IN MUSCULAR DYSTROPHY. Robert M. Dowben and Leon Zuckerman (Northwestern Univ., Evanston, Ill. and Chicago Wesley Memorial Hospital). Nature, 197: 400-1(Jan. 26, 1963).

Muscles from the limbs of rats exposed to 3000 r x radiation were analyzed for electrolytes. Measurements were also made of plasma electrolytes, aldolase, lactic dehydrogenase, and erythrocyte electrolytes. An apparent lowering of muscle K concentration and increase in Na and Cl concentrations was observed coincident with a loss of aldolase, creatine, and negative K balance. It is postulated that the findings are the result of a transient increase in cellular permeability of muscle. Similar conditions are present in hereditary muscular dystrophy. It is suggested that such changes in permeability of muscle cells may be a common reaction to certain kinds of injury and disturbances in metabolism. (C.H.)

14057 IRRADIATION OF FRUIT AND SIMULTANEOUS MEASUREMENT OF RESPIRATION. Roger J. Romani and J. Basil Bowers (Univ. of California, Davis). Nature, 197: 509(Feb. 2, 1963).

The effects of exposure to γ radiation on respiratory rate was measured in bing cherries. It is concluded that the respiratory rate of the whole fruit serves as a measure of the metabolic response induced by irradiation. (C.H.)

14058 NATURE OF THE PHOTOREACTIVABLE ULTRA-VIOLET LESION IN DEOXYRIBONUCLEIC ACID. Jane K. Setlow and Richard B. Setlow (Oak Ridge National Lab., Tenn.). Nature, 197: 560-2(Feb. 9, 1963).

Reaction mechanisms involved in the reactivation of biological activity of ultraviolet-inactivated transforming desoxyribonucleic acid were investigated. Emphasis was placed on the role of thymine dimers in biological reactivation in Escherichia coli desoxyribonucleic acid split by treatment with a yeast extract in the presence of light. Results from a series of studies indicate that the yeast photoreactivating preparation had little or no biological effect except that resulting from breakage of thymine dimers. It is concluded that the proportion of photoreactivable damage varies with different wave-lengths of inactivating radiation. (C.H.)

14059 EXPERIMENTAL OXIDATION OF HAEMOGLOBIN: EFFECT OF REPEATED WHOLE-BODY γ-RADIATION IN RATS. W. K. Metcalf (Univ. of Bristol, Eng.). Nature, 197: 709-10(Feb. 16, 1963).

The effects of repeated exposure to γ radiation on the sensitivity of hemoglobin oxidation was measured in rats following whole-body exposure to doses ranging from 30 to 500 rads. Doses of 500 rads produced a rapid increase in hemoglobin sensitivity that persisted for at least 3 mo. The effect was less pronounced with smaller doses. Re-irradiation of the animals within one month produced on earlier change in sensitivity and an earlier reversion. The mechanism of the change in hemoglobin sensitivity is not known. (C.H.)

14060 A MULTICOMPONENT X-RAY SURVIVAL CURVE FOR MOUSE LYMPHOSARCOMA CELLS IRRADIATED IN VIVO. W. E. Powers and L. J. Tolmach (Washing Univ., St. Louis). Nature, 197: 710-11(Feb. 16, 1963).

The radiosensitivity of cell populations comprising a solid, subcutaneous mouse lymphosarcoma was measured. Results suggest that the survival kinetics are determined mainly by cells of only two sensitivities. Data from 4 experiments are compared. (C.H.)

14061 EFFECTS OF CYSTEAMINE ON THE INCORPORATION OF Fe^{59} IN THE RAT LIVER CELLS IN VIVO BEFORE RADIATION. S. K. Brahma, A. Bose, and S. Bose (National Cancer Research Center, Calcutta). Naturwissenschaften, 49: 542-3(1962). (In German)

The degree of protection offered by cysteamine at the quantitative level of Fe^{59} incorporation in the rat liver cells was studied. The results are tabulated and show that the Fe^{59} incorporation in the nuclei and cytoplasm of the liver cells was greatly increased with radiation and decreased to almost normal level when radiation was preceded by cysteamine injection. Protective efficacies observed at the levels of nucleus, cytoplasm, and total cell were 92.7, 88.8, and 89.7%, respectively. (J.S.R.)

14062 THE 3.5-DAY EFFECT IN THE X-IRRADIATION OF CHICKEN EMBRYOS. H. Albers, H. Helfer, and L. Riesterer (Universität, Mainz). Naturwissenschaften, 49: 516(Nov. 1962). (In German)

In order to observe the development and vitality of chicken embryos before and after irradiation without halt-

ing the growth, the eggs were provided with plate glass windows. The results showed that at irradiation doses of 800 to 2400 r, the survival of the 13-somite stage embryos drops abruptly from 98 to 6%. These results had good reproducibility. This sharp decrease in the percentage survival corresponds to the 3.5-day effect in mice. In addition to the reduced survival, a dose-dependent retardation of the morphological development was also observed. (J.S.R.)

14063 ON THE DISTRIBUTION OF Cr^{51}-LABELED BONE MARROW CELLS IN IRRADIATED RATS. V. Gregušová and Š. Hupka (Oncological Research Inst., Bratislava). Neoplasma, 8: 577-82(1961).

Rat bone marrow cells were labeled by incubation with Cr^{51}, as Na_2CrO_4, at a concentration of 80-100 mc/ml for 1 hr at room temperature. Under these conditions 20 to 30% of the label was taken up by the cells, which contrasts with the 50 to 80% labeling of red cells under similar conditions. The bone marrow cells remain viable and the label can be removed by washing them 5 times with saline. When 10^8 labeled cells were injected into the tail vein of irradiated rats, the greatest accumulation of the cells 15 min later was in the capillaries of the lungs; lesser accumulations were noted in bone marrow, spleen, blood, kidney, liver, and heart (in decreasing order). Within the next 24 hr, radioactivity increased in spleen and bone marrow but declined in lungs, liver, and blood. All of the recipient rats were irradiated with 900 r in a Co^{60} cell. Since the survival time of the rats was dependent upon the number of bone marrow cells injected, it was concluded that some of the injected cells were successfully grafted in the hemopoietic system of the recipients. (H.H.D.)

14064 HALF-LETHAL AND LETHAL DOSES OF Co^{60} GAMMA RADIATION IN WISTAR RATS. A. Skupenová and Š. Hupka (Oncological Research Inst., Bratislava). Neoplasma, 8: 583-6(1961).

Wistar rats were submitted to single doses of 400, 500, 600, 700, 800, 850, 900, 1000, and 1100 r Co^{60} radiation at a dose rate of 73.4 r/hr and at a distance of 162 cm. The first symptoms of radiation were diarrhea, bleeding from the snout, later fading of the eye color, and progressive general weakness. The most frequent causes of death were internal hemorrhage, extensive pulmonary inflammation, and severe disorders of the gastrointestinal tract (perforation of the stomach and intestine, peritonitis, and strangulation of the bowel by obstruction). The changes seen after Co^{60} gamma irradiation were in close agreement with those arising from x irradiation. For each group the curve of survival was plotted and from the data the lethal dose levels calculated were: $LD_{50/30}$ = 706 r, with confidence limits 650 and 767 r, and $LD_{100/30}$ = 1070 r, with limits 910 and 1260 r. Under some conditions, irradiation with an LD_{100} dose lasted over 15 hr. (P.C.H.)

14065 THE PROTECTION BY BONE MARROW HOMOGRAFTS OF RABBITS IRRADIATED BY GAMMA RAYS FROM Co^{60}. Š. Hupka, Š. Šimko, V. Gregušova, A. Skupenová, and V. Thurzo (Oncological Research Inst., Bratislava). Neoplasma, 8: 587-91(1961).

Adult rabbits were irradiated with a lethal dose (1500 r given in 2 750-r doses at a 24-hr interval) from a Co^{60} source. A suspension of 300-700 × 10^6 homologous bone marrow cells were injected in some irradiated animals 48 hr postirradiation. Control animals died between the 11th and 14th day after irradiation with 1500 r. Peritonitis due to gastrointestinal perforation, pneumonia, and internal hemorrhage were the causes of death, but no purulent infections were observed. The same symptoms were also found in half of the animals irradiated with 1500 r and given bone marrow transplants. These died between the 19th and 24th day. The other half of these animals survived for more than 30 days. In the first 3 weeks a drop in erythrocyte counts occurred and an improvement was noted only in the fourth week in animals surviving after homotransplantation for more than 30 days and in controls that received 1000 r. However, in the animals with transplants the rise, as well as the absolute red cell count, was higher than in the controls given 1000 r. In all animals reticulocytes fell initially to zero, but later rose to a maximum. The maximum appeared first in the animals with transplanted bone marrow, surviving for more than 30 days, next in the animals with the bone marrow surviving for less than 30 days, and finally in the controls that received 1000 r. After a typical abrupt fall of leukocytes in all animals, an early rise was noted in animals with transplanted bone marrow. In the controls that had received 1000 r, a rise occurred but not before the fourth week. In the controls given 1500 r, no sign of recovery was noted. It was concluded that the homotransplants protected the animals from death in the acute stage of radiation disease; later mortality, in view of the symptoms observed, was ascribed to homologous disease. (P.C.H.)

14066 RADIATION EFFECTS ON MAN. RADIATION EXPOSURE AND BIOLOGICAL EFFECTS. Nucleonics, 21: No. 3, 46-7(Mar. 1963).

The mechanisms and biological effects of radiation are summarized. A small dose rate is noted to prolong the average life of certain small animals, perhaps by curtailing infectious diseases. (D.C.W.)

14067 RADIATION EFFECTS ON MAN. SOMATIC EFFECTS. L. D. Hamilton (Sloan-Kettering Inst. for Cancer Research, New York). Nucleonics, 21: No. 3, 48-53(Mar. 1963).

Early somatic effects of radiation, particularly for high dosages, are known. These are briefly discussed, and more attention is given to long term effects (such as tumors, leukemia, etc.) of low doses. Attempts to establish radiation thresholds for these effects are largely fruitless. Hypothesized mechanisms of carcinogenesis are discussed, and other effects such as lens opacity and sterility are briefly treated. Assessment of life-shortening by radiation is examined as well as its processes. Susceptibility of a fetus to leukemogenic effects of radiation is observed to be at least ten times that of an adult. 27 references. (D.C.W.)

14068 RADIATION EFFECTS ON MAN. HEREDITARY EFFECTS. William J. Schull (Univ. of Michigan, Ann Arbor). Nucleonics, 21: No. 3, 54-7(Mar. 1963).

The effects of parental exposure on the sex ratio, fetal and infant mortality, and congenital defects are examined. Genetic arguments for a change in sex ratio are advanced, but no real dose-effect relation can be advanced. Five of eight large studies find no dependence of mortality on parental exposure. Evidence for increase of congenital defects with exposure is presented, but no such significant effect is noted in survivors of the Hiroshima and Nagasaki bombings. 35 references. (D.C.W.)

14069 RADIATION EFFECTS ON MAN. RADIATION-PROTECTION STANDARDS. Lauriston S. Taylor (National Bureau of Standards, Washington, D. C.). Nucleonics, 21: No. 3, 58-60(Mar. 1963).

The bases of radiation dose standards are explained, and problems met in determining and applying them are discussed. The reasons for changes in standards are also clarified, and it is noted that no radiation worker has re-

ceived a demonstrable injury from a permissible exposure. (D.C.W.)

14070 SOME PROTECTION METHODS FOR CUTANEOUS IRRADIATION WITH FAST ELECTRONS. O. Trucchi (Università, Rome). Nuntius Radiol., 28: 701-13(Sept. 1962). (In Italian)

The influence exerted by some substances, particularly by fatty substances and cortisone derivatives, on the skin reaction to fast electrons is examined. The means employed were applied on the skin immediately before the irradiation; their effectiveness varies in relation with the dose fractionation; this decreases in general the capacity of the various substances tested of modifying the skin reaction. The changes induced by these means are both quantitative and relative to the course (anticipation of the appearance of the erythema); they may occur uniformly in all phases of the reaction or only in one (a change of the first phase of the erythema is usually observed). The quality of the excipient, the action of which is often responsible for the aggravation of the skin reaction, is to be taken into account in the evaluation of the typical effect of the medications. Within the limits of the doses employed (1000 rad in only a sitting, 5000 rad in case of fractionation) the influence of fatty substances on the skin reactions due to irradiation with quick electrons proved not to be marked but only scarcely appreciable. The mineral fats may increase the reaction due to quick electrons in some cases: they do not have, however, either a protective or therapeutic effect during the acute phase of the reaction. The cortisone derivatives are uneffective when they are directly and exclusively applied on the irradiated skin, while they are successfully used by general route, especially in the reactions of the mucous membranes produced by quick electrons; in any way, the topical use of cortisone derivatives with excipients deprived from mineral fats proved to be preferable. Among the physical means employed, the compression gave the best results, in the cases where it could be applied. (auth)

14071 SPECIES DIFFERENCES IN INCREASED OXYGEN CONSUMPTION DURING TOTAL-BODY X IRRADIATION. A. Vacek and L. Novak (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Physiol. Bohemoslov., 9: 247-50(1960).

The O_2 consumption of rats was increased during the course of whole-body x-irradiation at a rate of 50 r/min. Possible species differences in this response were investigated. In rats, O_2 consumption increased significantly as early as the first min of irradiation, but in the 8th minute it approaches the value in the control group. In chickens, O_2 consumption also increased in the first min of irradiation, and continued to rise during the whole period of irradiation (15 min). In rabbits, O_2 consumption increased markedly during the entire course of irradiation and at the 10th min was 100% above the control value. Hence the rise in O_2 consumption during irradiation is not species-specific, nor is it sex-specific. The results show that O_2 consumption increases with dose rates up to 100 r/min. In the 3 species studied, rises in O_2 consumption started within the first minute of irradiation, whereas the control groups decreased their O_2 consumption during the same period. The rapidity of the rise in O_2 consumption suggests a reflex mechanism for the observed respiratory reaction. Since spinal cord section can block the reaction, it is assumed that the rise in O_2 requirement is a nonspecific reaction of the organism to irradiation, conditioned mainly by afferent nervous impulses from the periphery. (P.C.H.)

14072 THE LEUKERGING REACTION IN RABBITS AFTER X-RAY IRRADIATION. Danuta Borecka and Stanislaw Kubicz. Polski Przeglad Radiol. i Med. Nuklearnej, 26: 525-30(Nov.-Dec. 1962). (In Polish)

Rabbits exposed to x rays at doses of 25, 50, 100, 200, and 500 r (180 kv, 18 mA, filtration 0.5 Cu plus 1.0 Al) showed an increase in the crude number of polymorphonuclear leukokytes after 3 to 6 hr. At the same time leukergic granulocytes containing small quantities of glyogen appeared. The leukergic reaction appeared early and was of relatively short duration, about 6 hours. (auth)

14073 THE INHIBITORY ACTION OF X-RAYS ON THE LEUKERGY EVOKED BY BACTERIAL AGENT. Danuta Borecka, Stanislaw Kubicz, and Zenobia Krolowna. Polski Przeglad Radiol. i Med. Nuklearnej, 26: 531-5 (Nov.-Dec. 1962). (In Polish)

In order to evaluate the damage of the leukocytic system after x irradiation of rabbits with high doses, the leukergic response was used. 100 and 900 r delivered to the skin of the animal (in the latter technique 100 r per week) did not show any qualitative or quantitative difference in the animal's reaction on intravenous injection of 100 million killed B. coli per kg of weight. 2000 r of the given dose (500 r per week) evoked marked inhibitin of the reactivity of the granulocytic system on the intravenous injection of 100 million killed B. coli per kg weight of animal. The typical course of the reaction was fully maintained. The return of the reaction to normal appeared in about 3 to 4 weeks after irradiation. The leukergic reaction on B. coli was checked cytochemically (glycogen) and by means of leukergic test (stickiness of granulocytes). The impaired function of the bone-marrow (inhibition of leukokytes production) speaks for the partially preserved regenerative power of the leukocyte system. (auth)

14074 NUMERICAL AND MORPHOLOGICAL CHANGES OF THE BLOOD CELLS IN WORKERS ENGAGED IN MINING AND PROCESSING OF RADIOACTIVE RAW MATERIALS. H. Polak, Vl. Rericha, Fr. Klestil, and J. Bartejs (Inst. of Labor Hygiene and Occupational Diseases, Jackymov, Czechoslovakia). Pracovni Lekar., 14: 413-20(Nov. 1962).

A comparison was made of complete hemograms of 417 uranium-mine employees, of which 347 worked mostly underground, with those of 84 hard-coal miners. The experimental group showed consistent relative and absolute lymphocytosis (presumed reactive overcompensation), neutropenia, eosinopenia (in contrast to British and U. S. reports of eosinophilia), erythiopenia, and considerable increase in malformed and abnormal leukocytes. Changes were attributed mainly to gamma rays. It was concluded that the dose received by the workers causes no severe lesion of blood cells, but it was not determined whether total dose has any effect. (OTS)

14075 EFFECT OF PELVIC IRRADIATION ON THE SECRETORY PARENCHYME OF THE KIDNEY. M. Bonino and G. Pisani (Universita, Turin). Radiobiol. Latina, 5: 99-145(Apr.-June 1962). (In Italian)

The authors have endeavored to establish if it is possible to find any functional or anatomical lesions either permanent or transitory, of the kidney in subjects irradiated on the pelvis when no radiations hit the kidney directly and there exist no alterations of the lower urinary passages due to the pelvic disease treated by irradiation or to post-irradiation fibrosclerotic processes. The research was performed along two lines: a) A research on a group of patients suffering from different types of tumors of the

pelvic region where a preliminary investigation could establish a normal renal function, whether the pelvic irradiation performed with various techniques and methods (radium, x-ray, and cobalt therapy) could obtain in an early or a late stage functional or possibly anatomical alterations of the renal parenchyme. b) An investigation in the animal on the possibility of irradiation focalized on the pelvis to elicit anatomic, microscopic, or cytohistochemic alterations of the renal parenchyme. The findings of the clinical investigation have revealed that a correct irradiation of the pelvis, even with high dosages, does not lead to alterations of the secretory renal function; secretory alterations, arising in the late post-irradiation stages should always be considered as an anatomo-functional response of the renal parenchyme to a prolonged mechanical obstacle of urinary excretion. The clinical findings received further support by the results of experimental research work with different techniques (histology, histochemistry, and electron microscopy) which have shown that irradiation of the pelvis both in humans and in animals (rat) is only followed by the onset of slight and quite reversible morphological alterations affecting the descending portion of Henle's tubule and the renal tubules. Actually, these structures of the kidney have no part in the process of urine elaboration. One may conclude that irradiation of the pelvis, provided it is given correctly, does not impair the urine secretion in a way which could be shown by common laboratory tests. This practice conclusion frees our mind from the feat of damaging such an important system of the organic balance, when we try to cure other sectors. (auth)

14076 EFFECTS OF IONIZING RADIATION ON THE STRUCTURE OF THE CEREBRAL CORTEX IN THE RAT. S. Greco (Università, Catania, Italy), A. Meriggi, E. Nesci, and L. Portigliotti. Radiobiol. Latina, 5: 147-75(Apr.-June 1962). (In Italian)

The authors have investigated the modifications of the cerebral cortex structure in the Long Ewans rat following single or fractioned irradiation with 1500 rad of x-ray or Co^{60} gamma rays localized on the animal skull. The observations were performed on animals sacrificed immediately or some hours to some months (7 months) after the irradiation and could establish that the cytological modifications of Purkinje's cells, the reduction of Purkinje's cells amount in the cerebellar laminae, and the decrease of the thickness of the molecular layer and the granular layer are all strictly related to the x or Co^{60} gamma irradiation. The authors study these aspects and discuss their significance. (auth)

14077 EARLY MODIFICATION OF THE SUCCINO-DEHYDROGENASE ACTIVITY IN THE BRAIN AND CEREBELLUM OF RATS IRRADIATED WITH Co^{60}. Renato Sorrentino and M. Luisa Tognacca (Università, Messina, Italy). Radiobiol. Latina, 5: 177-84(Apr.-June 1962). (In Italian)

The authors have studied the early behavior after irradiation of the succinodehydrogenasic activity in the brain and cerebellum of rats having undergone external teleirradiation by gamma-rays of Co^{60} with a beam concentrated on the region of the head. The animals, treated respectively with 500, 1500, 3000, and 4000 rad dosages were sacrificed some 10 min, 6 hr, 24 hr, and 7 days after the end of treatment. The amount of succino-dehydrogenase was established by the Kun and Aboods biochemical method and related to 100 mg of fresh weight of the tissue examined. Both in the brain and in the cerebellum of rats treated with the different doses there was an increase of the succino-dehydrogenasic activity 10' after the irradiation, which went gradually back to normal values during the following controls. (auth)

14078 THE BEHAVIOR OF THE PLASMA LEVELS OF SOME ENZYMES AND THE GLYCOLITIC AND TRANSAMINASE ACTIVITY IN PATIENTS WITH MALIGN NEOPLASMS BEFORE AND AFTER IRRADIATION. G. Savino and E. Fumagalli (Ospedale Maggiore, Novara, Italy). Radiobiol. Latina, 5: 185-94(Apr.-June 1962). (In Italian)

In 50 cases of malignancy treated by radiation (mostly by telecobalt therapy) the authors investigated the plasma levels of oxaloacetic and pyruvic transaminase, aldolase, and lactic dehydrogenase. Before irradiation, an increase in aldolase was frequently observed; it was unrelated to the location, spread, or histological type of the tumor. The other enzymes were within normal limits. After irradiation, the serum aldolase fluctuated, sometimes being raised and sometimes lowered. After a certain time, a return to normal levels was observed in cases showing amelioration clinically. (auth)

14079 DIET AS A FACTOR IN γ-IRRADIATION EFFECTS. Kh. F. Bass-Shadkhan. Tr. Inst. Eksperim. i Klinich. Med., Akad. Nauk Latv. SSR, No. 28, 117-28(1962).

The relationship between diet and the content of vitamins B_1, B_2, and B_{12} was studied in two sets of male albino rats. Group I was fed an experimental diet (milk, meat, cereal, vegetables, cottage cheese, yeast, salt); group II, a diet of biscuits made of high-grade flour and deficient in vitamins, proteins, and salts; and group III, a diet of biscuits made of high-grade flour supplemented with a protein-vitamin complex containing all the nutritional elements needed for normal metabolic processes. The highest amount of B_1 was found in the liver of group III rats and the smallest amount in group II. The contents of vitamins B_2 and B_{12} in the liver of all three groups were only slightly affected by the diet, and the contents of B_1 and B_2 in the brain were not affected at all. A second set of rats comprised four groups, two of them subjected to γ irradiation with 700 r. Group I had a fully adequate diet and was exposed to γ irradiation; group II (controls): fully adequate diet, no irradiation; group III: inadequate diet, γ irradiation; group IV (controls): inadequate diet, no irradiation. The vitamin contents were checked 36 hr and 5, 10, 20, and 50 days after irradiation. The B_1 content of the liver decreased in group I and increased in group III. The B_2 content of the liver did not change in group I, but increased slightly in group III. No changes were noted in the B_{12} content of the liver and in the amounts of B_1 and B_2 in the brain of the rats. (P.C.H.)

14080 DEVELOPMENT OF X-RAY-INDUCED LAMELLAR CATARACT IN THE NEWBORN MOUSE IN RELATION TO AGE AT TIME OF IRRADIATION. Walter H. Benedict (Oak Ridge National Lab., Tenn.). Trans. Am. Ophthalmol. Soc., 60: 373-407(1962).

X irradiation of newborn mice invariably produced lamellar cataracts, which progressed in severity when dosages of 300 r were used. This dose was effective in producing the lamellar type of cataract only, however, during the first three days after birth. Exposure to 300 r of x rays on the fifth day after birth, or later, did not lead to the development of lamellar cataracts, but sometimes led to subcapsular vacuoles after several months. Exposure in utero to 300 r on one, two, and three days before birth failed to produce lamellar cataracts in mice also. (P.C.H.)

14081 METHOD FOR DETERMINING INJURY FROM IONIZING RADIATION. Vestn. Cesk. Akad. Ved, 8: No. 9, 3-4(1962).

A method was developed for determining injury to the animal organism caused by ionizing radiation. It was discovered that after exposure of the animal to even a small dose of ionizing radiation its cell metabolism is affected, resulting in secretion of deoxycytidine into the urine. The larger the radiation dose, the larger the amount of deoxycytidine found in the urine. This method is considered more reliable than any other method and more practical, since its application does not affect the physiological condition of the animal. (P.C.H.)

14082 THE GROWTH OF MONODISPERSE POPULATIONS OF MAMMALIAN CELLS EXPOSED TO INTERNAL BETA IRRADIATION. Donald F. Petersen (Los Alamos Scientific Lab., N. Mex.). p.233-9 of "Mathematical Problems in the Biological Sciences." American Mathematical Society, 1962. (TID-13613; LADC-4796)

Radioactivity was introduced into HeLa cultures during logarithmic growth as tritiated thymidine or as tritium water, and the biological effects in internal beta irradiation were evaluated in terms of the decrement in growth observed in succeeding generations as a function of growth rate in control cultures where all components were nonradioactive. The data demonstrated that tritiated thymidine is more effective in inhibiting cell growth than tritium water. It was also indicated that decay of tritium incorporated into a specific macromolecular species exhibits a biological effect greater than that observed from a comparable number of random disintegrations within the volume of the nucleus. The data lend support to the contention that DNA is one of the most sensitive macromolecular specific within the cell. Speculation on the mechanisms involved is also included. (P.C.H.)

14083 LEUKEMIA IN ATOMIC BOMB SURVIVORS. A. B. Brill (Univ. of California, Berkeley), M. Tomonaga, and R. M. Heyssel. p.9-12 of "Proceedings of the VIIIth International Congress of Hematology, Tokyo, September 4-10, 1960." Tokyo, Pan Pacific Press, [1961].

Some of the findings of collaborative continuing studies on Japanese atomic bomb survivors are summarized. Topics covered include: qualitative leukemia risk after radiation, quantitative leukemia risk, time sequence of leukemia occurrence after radiation, population sensitivity, type of leukemia, natural history of the disease, and human leukemia risk as related to radiation parameters. (M.C.G.)

14084 CHANGES IN LYMPHATIC TISSUES DURING FOREIGN TISSUES TRANSPLANTATION. C. C. Congdon and Joan Wright Goodman (Oak Ridge National Lab., Tenn.). p.181-207 of "Proceedings of The International Symposium on Tissue Transplantation." Santiago, Chile, Universidad de Chile, 1962.

A review is presented on the response of irradiated and normal lymphatic tissue to foreign tissue transplants. From studies of normal lymphatic tissues and serial observation during the host-against-graft reactions, it was concluded that proliferation of dissociated germinal center cells and their migration into neighboring tissues was a characteristic of the inductive phase of the immune response. Anatomical changes in the lymphatic tissue of irradiated mice given foreign bone marrow are characterized by dissociated growth of immunologically competent cells in spleen white pulp and lymph nodes. The changes, which appear to be the cellular basis of the graft-against-host reactions, also have a limited time-course and are followed by necrosis and atrophy in the lymphatic organs. (P.C.H.)

14085 RADIOBIOLOGIYA—BIOLOGICHESKOE DEISTVIE IONIZIRUYUSHCHIKH IZLUCHENII. (Radiobiology—Biological Effects of Ionizing Radiation). David Emmanuilovich Grodzenskii. Moscow, Gosatomizdat, 1961. 132p.

Biological effects of ionizing radiation on cells and whole organisms are surveyed, and the problems of chemical protection and genetics effects are analyzed. (R.V.J.)

14086 RESPONSE OF MAMMALIAN SYSTEMS TO NONUNIFORM SPACE RADIATION DOSE. C. A. Sondhaus. [p.211-40 of "Lectures in Aerospace Medicine, Jan. 8-12, 1962."]

Discussion is given on the spatial distribution of radiation as well as its nature and energy throughout the body tissues during space flight, in particular, the geometrical aspect of tissue dose and non-uniform pattern of dose deposition, and its effect on response. A brief summary is given of conclusions derived from the accidental exposure of human being to fallout radiation on March 1, 1954, in the Marshall Islands. (P.C.H.)

Radiation Sickness

14087 (BNL-6643) THE DIAGNOSIS, TREATMENT, AND PROGNOSIS OF HUMAN RADIATION INJURY FROM WHOLE BODY EXPOSURE. Eugene P. Cronkite (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract [AT(30-2)-Gen-16]. 15p.

Radiation injuries in man are classified in three groups according to prognosis for recovery. The symptoms of each group are outlined and methods for the detection of radiation injuries are discussed. It is stressed that in the management of radiation injuries it is best to do nothing unless there are clear-cut clinical indications for a specific agent or maneuver. Procedures are outlined for the management of individuals exposed to high-level doses of radiation. (C.H.)

14088 (CEA-2207) ETUDE DE L'ACTIVITE RADIOPROTECTRICE DU NOYAU IMIDAZOLE ET DE QUELQUES UNS DE SES DERIVES. (A Study of the Radioprotective Activity of the Imidazole Nucleus and Some of Its Derivatives). R. Rinaldi and Y. Bernard (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Grenoble). 1962. 9p.

A study was made of the radioprotective properties of 8 compounds derived from imidazole. The effectiveness of the compounds was tested in mice exposed to a lethal dose of x radiation. Results showed that imidazole afforded protection to about 85% of the animals. Little protection was afforded by imidazolines and thione-imidazoline compounds in spite of the existence of a free sulfhydryl group in these compounds. (C.H.)

14089 (JPRS-17202) STUDY OF RADIATION SICKNESS. Translated from Patol. Fiziol. i Eksperim. Terapiya, 6: No. 5, 60-3; 74-5(Sept.-Oct. 1962). 9p.

A translation is presented of 2 articles in Patologicheskaya Fiziologiya i Experimental'naya Terapiya (Pathological Physiology and Experimental Therapy), Vol. 6, No. 5, Sept. and Oct. 1962. Separate abstracts were prepared for each paper. (M.C.G.)

14090 (JPRS-17202(p.1-6)) A COMPARISON OF THE CENTRAL DEPRESSING ACTION OF MEDINAL, BARBAMIL, AND THIOPENTAL DURING ACUTE RADIATION SICKNESS IN RATS AND RABBITS. M. Dostal. Translated from Patol. Fiziol. i Eksperim. Terapiya, 6: No. 5, 60-3(Sept.-Oct. 1962).

The narcotic action of barbiturates (medinal, barbamil, and thiopental) was compared in non-irradiated rats and in

rats after total x-irradiation with a 600 r dose, and also in non-irradiated rabbits and rabbits irradiated with a 900 r dose. The effects were evaluated according to the extent of depression of unconditioned reflexes. The rate of manifestation of the action of all the barbiturates tested in rats increased most on the 6th day after irradiation. The duration of the narcotic action diminished unreliably after the second introduction and approached its initial value after the third. (M.C.G.)

14091 (JPRS-17202(p.7-9)) THE EFFECT OF ACCELERATIONS CREATED AT THE MOMENT OF IRRADIATION OF ANIMALS ON THE COURSE OF ACUTE RADIATION SICKNESS. K. V. Ivanov, M. V. Zhukov, and M. G. Molchanova. Translated from Patol. Fiziol. i Eksperim. Terapiya, 6: No. 5, 74-5(Sept.-Oct. 1962).

The characteristics of the general reaction of an organism to the combined action of radial accelerations produced by rotating animals in a centrifuge and irradiation by penetrating radiations were investigated. The experiments were performed on 44 male mice weighing 110 to 120 g. Leukocytosis (116 to 198% of the initial content of leukocytes) was observed within 5 min after action in all rats rotated on the centrifuge. The number of blood leukocytes was decreased (from 81 to 29%) in rats irradiated without rotation. The most pronounced leukocytosis (140 to 180%) was noted in rats subjected to combined action. The average duration of life in rats subjected to irradiation alone was 8.7 ± 0.7 days, and in groups subjected to combined action, 10 ± 0.6 days. (M.C.G.)

14092 (JPRS-17222) AZERBAYDZHAN MEDICAL JOURNAL. Translation of Azerbaidzhanskii Meditsinskii Zhurnal, No. 10, 16-25; 31-42; 81-3(Oct. 1962). 35p.

Translations are presented for 5 articles in Azerbaidzhanskii Meditsinskii Zhurnal, No. 10, October 1962. Topics covered include: comparative data on surgical treatment of hip joint tuberculosis by transplantation of bone, comparative data on bone grafts in surgical treatment of tuberculosis of the hip joint, pathomorphological changes in the eye during acute radiation sickness, protective effect of β-mercaptoethylamine in acute radiation sickness, and characteristics of grape therapy, "ampelotherapy." Separate abstracts were prepared for 2 papers. (M.C.G.)

14093 (JPRS-17222(p.14-21)) PATHOMORPHOLOGICAL CHANGES IN THE EYE DURING ACUTE RADIATION SICKNESS. V. M. Abdullaev (Abullayev). Translated from Azerb. Med. Zh., No. 10, 31-5(Oct. 1962).

Radiation sickness was induced in dogs, rabbits, and guinea pigs by total-body irradiation. Among the diverse pathomorphological changes observed in the membranes of the eyeballs of the irradiated animals included: pronounced vascular reaction in the form of aneurysmal dilation and plethora of the vessels of all membranes, different degrees of hemorrhage, perivascular edema, pericellular infiltration, proliferation of the vascular endothelium, inflammatory infiltrates, dystrophic changes, and, in some cases, cloudiness of fibers of the crystalline lens in the posterior segment and formation of vesicular cells in different segments. The changes were most pronounced in dogs and rabbits while young animals of each species were more susceptible than mature individuals. (M.C.G.)

14094 (JPRS-17222(p.22-31)) PROTECTIVE EFFECT OF BETA-MERCAPTOETHYLAMINE IN ACUTE RADIATION SICKNESS. M. S. Isaev (Isayev). Translated from Azerb. Med. Zh., No. 10, 36-42(Oct. 1962).

The protective effects of β-mercaptoethylamine (BMEA) in single-dose and series total-body irradiation when the drug was administered several times were studied. It was found that BMEA contributed to the survival of 6 of 30 mice with radiation sickness induced by total-body irradiation with 800 r, which caused 100% mortality among irradiated animals not given BMEA. The protective effect of BMEA was also effective in series of exposures to radiation provided it was not injected too frequently (every 6th day). When given more frequently (every 4th day) the effect was insignificant, and when given every other day the test animals died much more rapidly than the irradiated animals not given BMEA. (M.C.G.)

14095 (JPRS-17872) BELORUSSIAN HEALTH. Translation of Zdravoohk. Belorussk, 8: No. 11, 34-41(1962). 13p. (OTS-63-21221)

14096 (JPRS-17872(p.1-8)) THE COURSE OF BURN SHOCK DURING VARIOUS PERIODS OF RADIATION SICKNESS. L. I. Rodina. Translated from Zdravookh. Belorussk, 8: No. 11, 34-8(1962).

An investigation was made on burn shock at various periods during acute radiation sickness. Work was carried out on 52 unanesthetized dogs weighing 10 to 12 kg. Burn trauma was inflicted on the animals after 30 min (initial period), after 24 hr (latent period), on the first manifestation of clinical signs of radiation sickness, and after 45 to 60 days following irradiation (convalescence). Acute radiation sickness in the initial, latent, and climactic periods markedly aggravated the course of burn shock and led to shortening of the life of the irradiated animals. In the initial and recovery periods, burn shock caused a prolonged visual and a shortened torpid stage. At the height of acute radiation sickness, the development of burn shock was characterized by a short and feeble erectile and a severe torpid phase. (P.C.H.)

14097 (JPRS-17872(p.9-13)) THE INFLUENCE OF THE CAUCASIAN YAM ON THE PROTEINS OF MICE, RATS, AND GUINEA PIGS DURING ACUTE RADIATION SICKNESS. V. Ya. Legchaev (Legchayev). Translated from Zdravookh. Belorussk, 8: No. 11, 39-41(1962).

White mice, rats, and guinea pigs were subjected to single whole-body x radiation in different doses. Tinctures of alcohol and rhizosomes of the caucasian yam, prepared in the ratio of 1:5, were given to the animals one time or several times, before and after irradiation. In white mice exposed to 400 r x irradiation, it was found that alcoholic and aqueous tinctures of yam prolonged the life of the animals by 9%. The therapeutic use of alcoholic and aqueous tinctures of yam in the doses employed proved ineffective in white rats, and the average length of life of the guinea pigs was reduced. (P.C.H.)

14098 RELATIONSHIP BETWEEN ACTIVITY OF FIBRINOGENASE AND INCREASED FIBRINOGEN CONTENT IN DOGS WITH RADIATION SICKNESS. K. V. Gordeyeva. Byul. Eksperim. Biol. i Med., No. 11, 39-42 (Nov. 1962).

Experiments were conducted on dogs to study the activity of fibrinogenase (in citrated blood plasma of test dogs) in acute radiation sickness accompanied by bleeding. After exposure, the period required for fibrinolysis usually increased, indicating a decrease in the activity of fibrinogenase. An increase in the fibrinogen content in the blood plasma of dogs with severe radiation sickness was a regular occurrence, taking place earlier in dogs with a pronounced hemorrhagic syndrome. No correlation was found between the changes in the fibrinogen content in the irradiated dogs and the changes in fibrinogenase activity. The coincidence of the increased fibrinogen content with the

development of hemorrhage leads to the assumption that it is a reaction of the latter. (OTS)

14099 EFFECT OF CYSTAMINE ON OXIDATIVE PHOSPHORYLATION IN SPLEEN OF IRRADIATED RATS. V. G. Vladimirov. Byul. Eksperim. Biol. i Med., No. 11, 55-8(Nov. 1962).

The effect of cystamine on oxidative phosphorylation in the spleen was investigated in white rats exposed to 600 r. A marked decrease in the rate of oxidative phosphorylation and in its effect on tissue respiration occurred in the control animals. Cystamine injected intraperitoneally before exposure increased the level of esterification of inorganic phosphates and the degree of association between phosphorylation and tissue respiration, but not to the normal level. The data indicate that cystamine lessens, but does not fully eliminate, postradiation disturbances in oxidative phosphorylation in rat spleen. (OTS)

14100 A STUDY OF THE LATE EFFECTS OF TOTAL BODY IRRADIATION. George L. Jordan, Jr., Vincent P. Collins, and Robert A. Hettig (Baylor Univ., Houston, Tex. and Veterans Administration Hospital, [Houston, Tex.]). J. Am. Med. Assoc., 183: 859-60(Mar. 9, 1963).

Results are reported from physiologic studies in dogs surviving large doses of whole-body x irradiation after treatment with transplants of fresh bone marrow, frozen marrow, or autologous spleen homogenates. Data are presented on blood formation, serum electrolytes, serum electrophoretic patterns, renal function, thyroid function, parathyroid function, adrenal function, serum amylose concentration, glucose metabolism, hepatic function, the development of infections, and the development of malignancy. Seven of 14 dogs treated with fresh marrow survived exposure to 700 r and 2 of 8 survived exposure to 850 r. Three dogs of 5 treated with autologous bone marrow survived. The technique of freezing bone marrow was not satisfactory and only one dog treated with frozen marrow survived. Results indicated a return to normal in all physiologic parameters of irradiated dogs treated with bone marrow transplantation. (C.H.)

14101 THE INFLUENCE OF VITAMIN B_{12} ON THE CONTENT OF NUCLEIC ACIDS IN THE BLOOD-FORMING ORGANS OF IRRADIATED ANIMALS. Z. I. Sheremet and L. I. Kazanova (Inst. of Hematology and Blood Transfusion, USSR). Med. Radiol., 8: No. 1, 46-54(Jan. 1963). (In Russian)

Changes in the content of nucleic acids (biochemical and cytochemical techniques) were investigated in comparison with the peculiarities of myeloid cells in the bone marrow and spleen of guinea pigs during irradiation (300 r), in administration of vitamin B_{12} (10 μg on alternating days) and in simultaneous action of irradiation and vitamin B_{12}. A sharp decline was noted in the content of nucleic acids in the bone marrow and a somewhat lesser drop in the spleen of guinea pigs 1, 3, and 7 days after irradiation. Administration of vitamin B_{12} in the first half of radiation sickness caused a greater decrease of DNA in the bone marrow and a more marked aplasia of the bone marrow in the majority of the animals. The content of RNA in the bone marrow and the DNA and RNA level in the spleen showed no essential changes. (auth)

14102 QUANTITATIVE CHANGES OF EXTRACELLULAR WATER DURING THE COURSE OF RADIATION SICKNESS. S. Kosmider and E. Rogala (Silesian Medical Inst., Labrze, Poland). Med. Radiol., 8: No. 1, 54-8(Jan. 1963). (In Russian)

Quantitative investigations were made of the extracellular water during the course of radiation sickness in rabbits (with the use of sodium rhodanate). After irradiation of rabbits in doses of 200, 500, and 800 r, the quantity of extracellular water decreased. Diminution of the extracellular water was greater than the animal's weight loss, this testifying to displacement of the water from the extracellular medium into the cells (swelling). The phenomenon depends upon the dose of irradiation: the higher the dose, the shorter the time of swelling. An opinion is set forth that the terms of appearance of morphological changes are in relation to the speed of swelling and the reverse process. (auth)

14103 THE THERAPEUTIC EFFECT OF PURIFIED PROPERDIN IN MICE WITH ACUTE RADIATION SICKNESS. V. Ya. Vissarionova and I. L. Chertkov (Inst. of Hematology and Blood Transfusion, USSR). Med. Radiol., 8: No. 1, 62-4(Jan. 1963). (In Russian)

Mice were subjected to an absolute lethal dose of x rays (750 r). It is shown that intravenous administration of purified properdin in a dose of 3000 units/kg to mice at different periods after the irradiation caused an insignificant rise of the average life expectation of mice and in some experiments it was conducive to the survival of 10 to 15% of the animals. (auth)

14104 CHANGES IN THE CARDIOVASCULAR SYSTEM OF DOGS WITH RADIATION SICKNESS CAUSED BY THE EFFECT OF URANIUM FISSION PRODUCTS. G. K. Korolev. Med. Radiol., 8: No. 1, 64-70(Jan. 1963). (In Russian)

Investigations of the cardiovascular system in dogs subjected to the action of uranium fission products revealed that in the immediate postirradiation days there occur a deceleration of the pulse rate, decrease of the arterial pressure, and changes of the electrocardiogram. Disturbances in the cardiovascular system were greatest at the peak of the disease. The nature of electrocardiographic changes demonstrated that products of uranium fission provoke profound biochemical changes in the myocardium. The products can cause the development of coronarytrophic disorders. Changes in the cardiovascular system occurring under the influence of lethal doses of uranium fission products did not differ essentially from those due to the action of gamma- and x-irradiation. Only an absence of initial manifestations in response to the effect of these products was seen. (auth)

14105 POLYCARBOXYLIC AND PHOSPHONITRILIC ACIDS AS RADIOPROTECTORS: EFFECTIVENESS OF PYROMELLITIC ACID. J. H. Barnes and J. St. L. Philpot (Medical Research Council, Harwell, Berks, Eng.). Nature, 197: 248-9(Jan. 19, 1962).

The ability of multiple acidic groups associated with a ring or short open-chain structure to protect mice against x-ray lethality when injected before irradiation was tested. None of the phosphonitrilates tested show any significant radioprotective effects. Of the polycarboxylic acids used, only pyromellitic acid showed a marked degree of protection. The protective effect of pyromellitic acid is highly significant ($P < 10^{-4}$) at a dose level of 9mmoles/kg (conc 0.3M), when only a mild depressant effect is observable, which is not modified by exposure to x rays, and the dose is substantially less than the maximum tolerated. The protective effect at 9mmoles/kg is significantly greater ($P < 0.02$) than at 12mmoles/kg when the depressant effect is more marked, indicating that the radioprotective effect is not merely a manifestation of toxicity. Pyromellitic acid is ineffective when given 30 min before irradiation and has no influence on mortality when given immediately after 1,025 r. (H.G.G.)

14106 FACTORS MODIFYING THE POST-RADIATION EFFECTS OF HOMOLOGOUS SPLEEN. Giancarlo Rabotti and Ioulios Iossifides (Jefferson Medical Coll., Philadelphia). Nature, 197: 199-200(Jan. 12, 1963).

The administration of adult parental splenic cells into supra-lethally x-irradiated animals results in an early death of the injected recipients, to the extent that they die even earlier than the uninoculated irradiated controls. The factors that influence this "splenic death" are radiation dose, degree of histo-incompatibility, time of the post-radiation splenic injection, dose of splenic cells, and age of the donor of splenic cells. Radiation doses of 400-500 r resulted in no deaths in the control or treated animals, but exposures at 600 r caused death within three weeks to all animals treated with spleen cells. Larger amounts of irradiation presumably destroyed the capacity to react against donor spleen cells, which were therefore able to act against the host. The killing effect is always present when infusions are made within 20 hrs following irradiation. The phenomenon disappears when the spleen cells are given 5 days after exposure to the threshold dose. The lethal effect of homologous spleen is still present 5 days later if the recipient is exposed to higher x-ray doses. (H.G.G.)

14107 UNFAVOURABLE RESPONSE OF RADIATION NEPHRITIS TO ADMINISTRATION OF L-TRIIODOTHYRONINE. William L. Caldwell (Rodriguez U. S. Army Hospital), Robert W. Thomassen, and Antonio Bosch. Nature, 197: 200-1(Jan. 12, 1963).

More severe histopathologic changes in the irradiated kidneys of the 3,5,3′-L-triiodothyronine treated rabbits than in the irradiated kidneys of the control group were observed. No reasonable explanation for this unexpected deleterious effect of T-3 is given, but the results suggest that T-3 is not an effective modifier of radiation damage in the kidneys of rabbits. (H.G.G.)

14108 ISOLATION OF A RADIATION-MORTALITY REDUCING FACTOR FROM SPLEEN. Sam Katz and F. Ellinger (Naval Medical Research Inst., Bethesda, Md.). Nature, 197: 397-9(Jan. 26, 1963).

A procedure is described for the isolation of a fraction from spleen extract that contains a radiation-mortality reducing factor. Preliminary data suggest that the factor is associated with a polypeptide or protein. (C.H.)

14109 RADIATION PROTECTION BY CYANIDE OF BOTH RATS AND MICE. Jack Schubert and Joan Fried Markley (Universidad de Buenos Aires). Nature, 197: 399-400(Jan. 26, 1963).

The effects of treatment with sodium cyanide on the survival of x-irradiated rats and mice were compared for a wide range of doses. Significant protection was obtained in both rats and mice exposed to whole-body radiation doses ranging from 650 to 850 r. Possible reaction mechanisms involved are discussed. (C.H.)

14110 RECOVERY FROM RADIATION INJURY: A PROPOSED MECHANISM. Robert F. Kallman (Stanford Univ. School of Medicine, Palo Alto, Calif.). Nature, 197: 557-60(Feb. 9, 1963).

Biological systems varying widely in complexity were examined for factors influencing recovery from radiation injury. The effects on survival of single, acute radiation exposure were compared with the effects of doses given in two fractions. Curves are included showing the effectiveness of a second dose of radiation as a function of time between first and second dose. An hypothesis is presented for recovery of mammalian tumor cells from radiation injury. (C.H.)

14111 THE EFFECT OF VEGETABLE OILS ON THE RADIATION DAMAGE IN MICE AND RATS. Kurt Flemming (Universität, Freiburg i. B.). Naturwissenschaften, 49: 516-17(Nov. 1962). (In German)

The therapeutic and protective effects of olive oil, sunflower oil, linseed oil, and peanut oil were investigated on mice exposed to 690 and 640 r whole-body irradiation and on rats exposed to 735 r. The therapeutic effect of olive oil and its protective effect when injected 24 hrs before the irradiation were confirmed. The other oils had a similar effect when injected before irradiation. The mechanism of the protective effect is discussed. (J.S.R.)

14112 CHEMICAL RADIOPROTECTIVE AGENTS. [PART] I. Fereno Hernadi (Debrecen Coll. of Medicine, Hungary). Orv. Hetilap, 103: 2222-6(Nov. 25, 1962).

A review is presented on chemical compounds that are able to prevent or reduce the development of radiation reaction as well as increase the resistance of the organism to radiation when present in the body prior to irradiation. The most effective radioprotective compounds may be divided into the following groups: cyanides and nitriles (example: KCN, malonic acid dinitrile), sulfhydryl compounds (cystamine), amines (adrenaline, histamine), hormones (estrogens), anoxia producers (barbiturates, CO), chelate builders (diethyldithiocarbamate), and metabolites and neutral substances (fructose, fluoroacetate). Methods for the evaluation of radioprotective agents are also discussed. (OTS)

14113 EFFECT OF DIET ON RADIATION SICKNESS. A. A. Nozhenko. Tr. Inst. Eksperim. i Klinich. Med., Akad. Nauk Latv. SSR, No. 28, 83-6(1962).

A protein-vitamin complex, which contains all the nutritional elements needed for normal metabolic processes, was used for the prevention of harmful radiation effects. The complex, prepared from animal and vegetable products, contains mineral substances (macro- and microelements), vitamins (B-group), carotene, and proteins (15.5%). It produced a marked antiradiation effect in experiments with albino rats subjected to ionizing radiation with a dose of 700 r. It is believed that the data may serve as a basis for producing a rational diet for patients suffering from radiation sickness. (P.C.H.)

CHEMISTRY

General and Miscellaneous

14114 (ANL-6562) BOILING WATER REACTOR TECHNOLOGY STATUS OF THE ART REPORT. VOLUME II. WATER CHEMISTRY AND CORROSION. C. R. Breden (Argonne National Lab., Ill.). Feb. 1963. Contract W-31-109-eng-38. 252p.

Information concerning the corrosive effects of water in power reactor moderator-coolant systems is presented. The information is based on investigations reported in the unclassified literature believed to be fairly complete to 1959, but less complete since then. The material is presented in sections on water decomposition, water chemistry, materials corrosion, corrosion product deposits, and radioactivity. It is noted that the report is presented as a part of a continuing program in development of less expensive materials for use in reactors. (J.R.D.)

14115 (ANL-6596) CHEMICAL ENGINEERING DIVISION SUMMARY REPORT, JULY–SEPTEMBER 1962. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 218p.

A total of six sections is included in the report. Separate abstracts were prepared for each section. (J.R.D.)

14116 (ANL-6596(p.29-118)) CHEMICAL-METALLURGICAL PROCESSING. R. K. Steunenberg, L. Burris, Jr., et al. (Argonne National Lab., Ill.).

Pyrometallurgical development is reported on melt refining, processes utilizing metal solvents, and reactor materials. Design of fuel-processing facilities for EBR-II is reported and the status of the fuel cycle facility is discussed along with development of process and service equipment. Investigations of liquid metals to provide data for use in design of fuel processes are reported. Data and information are included concerning solubilities in liquid metals, thermodynamic measurements of liquid metal solvents, and magnetic studies of UCd_{11} intermetallic. (J.R.D.)

14117 (ANL-6596(p.119-63)) FUEL CYCLE APPLICATIONS OF VOLATILITY AND FLUIDIZATION TECHNIQUES. J. Fischer, L. Trevorrow, et al. (Argonne National Lab., Ill.).

The development of a direct fluorination volatility process for Pu and U recovery from irradiated fuels was continued. Investigations are reported on separation of PuF_6–UF_6 mixtures by selective decomposition, filtration of Pu particles from exhaust systems, PuF_6 radiosynthesis from UF_4, and on calculations concerning alpha particle-induced decomposition of PuF_6. Other investigations are reported on fluoride volatility processes, preparation of dense UO_2 particles in conversion from UF_6, and fluid-bed studies in small-diameter columns. (J.R.D.)

14118 (ANL-6596(p.164-74)) CALORIMETRY. W. N. Hubbard, H. M. Feder, et al. (Argonne National Lab., Ill.).

A program to determine thermodynamic data for compounds of interest in high-temperature chemistry is described. Information is presented concerning combustion of ZrD_2 and ZrH_2 in O_2 and combustion of Al, Cd, Mg, Zn, U, and ZrB_2 in F_2. (J.R.D.)

14119 (ANL-6596(p.175-200)) REACTOR SAFETY. L. Baker, J. G. Schnizlein, et al. (Argonne National Lab., Ill.).

The oxidation, ignition, and combustion of U and low-level binary U alloys are being studied to provide information useful in minimizing handling hazards. Information is presented on metal-oxidation and ignition kinetics, and metal-water reactions. (J.R.D.)

14120 (ANL-6596(p.201-10)) ENERGY CONVERSION. C. E. Crouthamel, M. Foster, et al. (Argonne National Lab., Ill.).

Research concerning the conversion of nuclear energy to electricity by use of regenerative emf cells and by thermoelectricity is reported. (J.R.D.)

14121 (ANL-6596(p.211-17)) DETERMINATION OF NUCLEAR CONSTANTS. C. Crouthamel, D. Stupegia, et al. (Argonne National Lab., Ill.).

Information is presented on fast neutron capture cross sections of Th^{232} along with data and information on capture, fission, and (n,2n) reactions in EBR-I. (J.R.D.)

14122 (NAA-SR-Memo-7815) CORRELATION OF VOID FRACTION FOR SANTOWAX-R DURING FORCED CIRCULATION BOILING AT LOW PRESSURE. F. Bergonzoli and F. J. Halfen (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Oct. 29, 1962. Contract [AT(11-1)-Gen-8]. 26p.

The void fraction of Santowax-R was determined for nucleate boiling in upflow forced circulation. The investigation was conducted to obtain and correlate void fraction data for subcooled and bulk boiling in Santowax-R at low system pressures. The resulting data are analyzed. (J.R.D.)

14123 (TID-17366) SCINTILLATING ANION EXCHANGE RESIN. Progress Report No. 3, November 1962. A. H. Heimbuch (Tracerlab. Div. of Lab. for Electronics, Inc., Richmond, Calif.). Contract AT(30-1)-2885. 15p.

An anion resin with an exchange capacity of 0.03 milliequivalents per gram was made from scintillating beads containing 9,10-diphenylanthracene as a wave shifter. The pulse-height reduction was approximately 25% (compared with the untreated beads). By comparison, the best anion resin preparation reported in the second progress report had an exchange capacity of 0.016 milliequivalents with a pulse-height reduction of 33%. (J.R.D.)

14124 (UCRL-10404) BIBLIOGRAPHY FOR HINDERED INTERNAL ROTATION AND MICROWAVE SPECTROSCOPY. D. R. Herschbach (California. Univ., Berkeley. Lawrence Radiation Lab.). Oct. 1962. Contract W-7405-eng-48. 30p.

A bibliography containing 201 references is presented along with tables summarizing various experimental results. (J.R.D.)

14125 (JPRS-17684) TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 19. Translated from K'o Hsueh T'ung Pao, No. 11, 41-5; 46-7; 50-7(Nov. 1962). 49p.

Translations are presented for nine selected papers. These papers deal with gas phase chromatography, extraction of rare earths and tungsten, hydrothermal iron chloritoid in molybdenum ore, the 1962 meetings of the Chinese Anatomical and Astronomical Societies, a fluidization conference, hygiene for farming villages, and finally the table of contents of the Chinese journal. A separate abstract was prepared for one of the papers. (D.L.C.)

14126 (JPRS-17684(p.19-20)) THE EXTRACTION OF RARE EARTH ELEMENTS WITH PAPER STRIP DISTRI-

BUTION. Shu-wei Pang (P'ang) and Shu-ch'en Liang. Translated from K'o Hseuh T'ung Pao, No. 11, 46(Nov. 1962).

Separation of the rare earths using a toluene solution of di(2-ethylhexyl) ortho-phosphoric acid spread on filter paper is reported. An acetic acid solution of sodium sulfate is used as the washing agent. The process takes ~6 hr, and an alcohol solution is used to show the spots. The kind and extent of the separations vary with the pH of the washing solutions. (D.L.C.)

14127 COMPARISON OF THE REACTIONS OF AMIDINOUREA AND AMIDINOTHIOUREA WITH VARIOUS METAL IONS. Russell H. Trimble (Davidson Coll., N. C.). Anal. Chem., 34: 1633-5(Nov. 1962).

Amidinourea was compared with amidinothiourea as an analytical reagent for identification of certain metals. Salts of 20 metals were tested to determine their reactions with both reagents. Those salts that formed derivatives were studied further. These derivatives were prepared in quantity, then analyzed to determine the mole ratio of metal to reagent. Amidinourea and amidinothiourea combine with nickel in a 1:2 mole ratio. Amidinothiourea combines with copper in a 1:1 ratio, whereas amidinourea combines in a 1:2 ratio. Amidinothiourea forms a stable, water-soluble complex with cobalt in a slightly acidic solution, but a water-insoluble compound in an alkaline solution; amidinourea does not form a stable complex. Amidinourea forms a stable compound with silver, but amidinothiourea does not. (auth)

14128 DECOMPOSITION OF CHEMICALLY ACTIVATED ETHYL-$\underline{d}_3$ RADICALS. PRIMARY INTRAMOLECULAR KINETIC ISOTOPE EFFECT IN A NONEQUILIBRIUM SYSTEM. J. H. Current and B. S. Rabinovitch (Univ. of Washington, Seattle). J. Chem. Phys., 38: 783-95 (Feb. 15, 1963).

The rate of decomposition of ethyl-$\underline{d}_3$ radicals formed by chemical activation was studied at 195 and 300°K over the pressure range from 0.05 to 3.0 mm. The excited radicals decomposed by hydrogen or deuterium atom rupture or were collisionally stabilized. The rate of decomposition was determined relative to the rate of stabilization by complete product analysis. Detailed description is given. The limiting high-pressure rate for hydrogen rupture from energized ethyl-$\underline{d}_3$ radicals was determined to be 6.5×10^7 sec^{-1} at 300°K and 2.5×10^7 sec^{-1} at 195°K. The limiting low-pressure rate for hydrogen rupture was found to be 2.0×10^7 sec^{-1} at 300°K and 1.0×10^7 sec^{-1} at 195°K. The intramolecular hydrogen to deuterium rupture ratio was determined to be ~2.0 at 300°K and ~3.0 at 195°K for this nonequilibrium reaction system, and appreciably less than similar ratios determined earlier for the ethyl-$\underline{d}_2$ system. The disproportionation to recombination ratio for ethyl radicals was found to be 0.14 at 300°K and to be 0.17 at 195°K. The apparent isotopic H/D disproportionation ratio in ethyl-$\underline{d}_3$, measured at both temperatures, was 1.6 in reasonable agreement with the value of 1.4 of Boddy and Steacie. Theoretical rates were calculated from a quantum statistical harmonic oscillator formulation of the rate constant. Good qualitative and semiquantitative agreement was found between the various experimental quantities of this study (as well as a previous one dealing with ethyl-$\underline{d}_2$ radicals) and magnitudes calculated from a model which has quite a loose activated complex (150 cm^{-1}, C–C–H bends) with the figure axis rotation active, and in which the energized radical has both an active free internal rotation and figure axis rotation. (auth)

14129 ORIGIN OF THE PHOSPHORESCENCE RADIATION IN AROMATIC HYDROCARBONS. M. A. El-Sayed (Univ. of California, Los Angeles). Nature, 197: 481-2 (Feb. 2, 1963).

Results are reported from a series of studies on the origin of phosphorescence radiation in aromatic hydrocarbons. Results indicate that the phosphorescence mechanism is insensitive to the symmetry, the planarity, or to the details of the fine structure of these molecules. Possible causes for the effect are considered. (C.H.)

14130 PREPARATION OF CARCINOGENIC POLYNUCLEAR HYDROCARBONS LABELLED WITH TRITIUM BY WILZBACH'S METHOD. William LiJinsky and Humberto Garcia (Univ. of Chicago). Nature, 197: 688-90(Feb. 16, 1963).

Procedures are described for the preparation of tritium-labeled polynuclear hydrocarbon carcinogens for use in biological investigations. Samples of benzo(a)pyrene, 7,12-dimethylbenz(a)anthracene, and 20-methylcholanthrene were exposed to tritium for 2 weeks. Data are presented on the specific activities and distribution of radioactivity in reaction products of the hydrocarbons. (C.H.)

14131 INFLUENCE OF POLYVALENT CATIONS ON THE RATE OF ELECTRO-REDUCTION AND AQUATION OF $Co(NH_3)_5X^{n+}$ COMPLEXES. A. A. Vlček (Polarographic Inst., Caechoslovak Academy of Sciences, Prague). Nature, 197: 786-7(Feb. 23, 1963).

Results are reported from studies on the effects of Th^{4+}, La^3, and Ba^3 on the rate of reduction of $Co(NH_3)_5F^{2+}$, $Co(NH_3)_5SO_4^+$, and $Co(NH_3)_5H_2O^{3+}$. Results indicated that specific affinity ligand-cation contributes considerably to the stability of the ion pair. Results are included from measurements on the rate of aquation of $Co(NH_3)_5F^{2+}$ under the influence of Th^{4+} ions. It was concluded that an association of the complex cation with the metallic ion occurs, with the ligand X acting as a bridge between the two metals. In the ion pair formed, a certain fraction of electron density is transferred to the bond M-X, so that the bond X-Co is loosened which facilitates the aquation. (C.H.)

Analytical Procedures

Refer also to abstract 14771.

14132 (AAEC/TM-175) THE SPECTROPHOTOMETRIC DETERMINATION OF BERYLLIUM WITH CHROME AZUROL S. P. Pakalns (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Jan. 1963. 13p.

A comprehensive investigation of the spectrophotometric determination of Be with Chrome Azurol S is described. At pH 4.6, and in the presence of EDTA, only Cr-III and F ions interfere seriously. A molar absorptivity of 4060 at 569 mμ was found for the complex, with a standard deviation of ±0.4% at the 25-μg Be level. Chrome Azurol S has several advantages over Berillon II, which is widely used for the spectrophotometric determination of Be. (auth)

14133 (AERE-AM-93) A RAPID DETERMINATION OF CAESIUM-137 (TETRAPHENYLBORATE EXTRACTION). W. Jenkins and M. Perkins (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England). Jan. 1963. 7p.

Following the removal of radioiodine and radioruthenium, Cs-137 is extracted as the tetraphenylborate complex into amyl acetate. The extract is then γ counted in a well crys-

tal. A single determination can be completed in one hour. (auth)

14134 (AERE-R-4141) AN AUTOMATIC INTEGRATING FLAME PHOTOMETER OF HIGH SENSITIVITY. F. W. J. Garton, J. L. Waddingham, P. C. Wildy, H. M. Davis, and S. J. Hawkins (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England). Nov. 1962. 44p.

A flame photometer employing interference filters for the isolation of Ca, Na, and Li radiation and a gelatine filter for the isolation of K radiation is described. A determination is made on a single drop (0.01 ml) of solution dried on a Pt wire and inserted into an air-acetylene flame that is air-conditioned. The light impulse is measured by a photomultiplier and an integrating circuit. Automatic background correction is employed, the meter reading measuring the differential output of the two Miller-type circuits. This arrangement permits a limit of detection of 5×10^{-13} g of Li in aqueous solution. (auth)

14135 (AERE-R-4210) SOME CONSIDERATIONS REGARDING THE APPLICATION OF X-RAY EMISSION SPECTROGRAPHY TO ANALYTICAL PROBLEMS AT A.E.R.E. B. L. Taylor (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Jan. 1963. 14p.

Features of x-ray-emission spectrography that are of importance in judging its applicability to analytical work in the Actinide Analysis Group at A.E.R.E. are discussed. Types of analysis in which the method is likely to prove useful are mentioned, and brief details are given of experimental work concerning the determination of Zr and Ti in U materials. (auth)

14136 (CEA-2202) ANALYSE ISOTOPIQUE DE L'URANIUM PAR INTERFEROMETRIE. (Isotope Analysis of Uranium by Interferometry). J. P. Leicknam (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay). 1962. 11p.

Among the optical methods which may be used to make isotopic measurements of U^{235} interferometry gives promising results. An apparatus is described which has a photomultiplier as receiver; the source must therefore have characteristics (intensity, stability, fineness of emitted rays) which have led to the use of electrode-less discharge tubes whose methods of production and excitation are given. An example of calibration is given. (auth)

14137 (DP-619) ANALYTICAL METHOD FOR IN-LINE PLUTONIUM ANALYSES. Robert F. Overman (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Aug. 1961. Contract AT(07-2)-1. 9p.

Laboratory studies demonstrated the feasibility of a colorimetric method for the in-line analysis of plutonium(III) and plutonium(IV) in the Purex process. Negligible interference was caused by normal variations in the concentration of nitric acid, nitrous acid, or ferric sulfate. (auth)

14138 (HW-67067) A TENTATIVE BIOASSAY PROCEDURE FOR THE MEASUREMENT OF Np^{237}. R. W. Perkins (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 10, 1960. Contract AT(45-1)-1350. 3p.

A procedure is described for the measurement of Np^{237} in urine samples. The procedure involves precipitation followed by extraction of the Np^{237}. The Np^{237} may either be plated and α counted directly or electrodeposited and measured by a nuclear track counting technique. (C.H.)

14139 (IEA-56) THE USE OF SEPARAN AS A MAXIMUM SUPPRESSOR IN POLAROGRAPHY. Alcidio Abrao (Brazil. Instituto de Energia Atomica, Sao Paulo). Nov. 1962. 13p.

The extensive use of separan as a maximum suppressor in Polarography is described. Like the gelatin, separan can suppress the maxima of various metal ions over a wide range of potential, and it can be used in acid, alkaline (or ammoniacal) as well as in neutral media, having the additional advantage that the reagent is stable for a long time and does not decrease the diffusion current when applied in concentrations up to 1.0%. Measurements of U–VI in U–IV, of Zn, Pb, Cu, and Te were accomplished in the presence of separan. (auth)

14140 (N62-11516) RESEARCH ON ANALYTICAL METHODS FOR OXYGEN IN LIQUID ALKALI METALS. Quarterly Progress Report No. 5, January 1, 1962–March 31, 1962. Hyman Kirtchik and George Riechmann (General Electric Co. Flight Propulsion Lab. Dept., Evendale, Ohio). Apr. 17, 1962. Contract NASr-12. 14p. (DM-62-124)

Instrumentation of the HF-F_2 apparatus was redesigned so as to reduce the volume of the reaction cell, improve the AHF (anhydrous HF) transfer, provide a means of adding a potassium sample under inert conditions, and improve the overall exit-gas leak rate of the system. A method for the analysis of low concentrations of oxygen in the exit cell gases was established and the instruments calibrated. Two approaches for removing fluorine and oxygen difluoride from the exit gases, leaving only oxygen and argon, are being evaluated. Potassium metal reaction with AHF was further investigated. The development of a technique to prepare metal samples for round-robin interlaboratory testing was initiated. (auth)

14141 (NLCO-866) MORE EFFICIENT QUANTOMETRIC ANALYSIS BASED ON SIMULTANEOUS CHARGE AND READ (SCARFU) OPERATION. J. W. Theiring and H. A. Heller (National Lead Co. of Ohio, Cincinnati). Jan. 21, 1963. Contract AT(30-1)-1156. 24p.

Development of a modified simultaneous charge and read function unit (SCARFU) by re-wiring the quantometer integrator units to permit use of both banks of the installed capacitors is reported. The design is such that the SCARFU system can be disengaged, and the quantometer returned to its original mode of operation by one switch. The use of SCARFU reduces the operator man-hours required for quantometric U_3O_8 analysis by 50% while allowing for similar or higher throughput. (J.R.D.)

14142 (PAN-370/VIII) SPECTRAL ANALYSIS BY THE POWDER SIFTING METHOD. PART IV. SIFTING TECHNIQUE BY MEANS OF ELECTRODE WITH AN EXCHANGEABLE PRESSED SIEVE BOTTOM. Julian Czakow (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Nov. 1962. 12p.

A type of sieve electrode with an exchangeable pressed bottom, as well as the method of manufacturing the pressed sieve bottom in the laboratory, are described here. The use of an electrode with a pressed bottom enables a simple and economical application of the sifting technique to powder and solution analysis. (auth)

14143 (PG-Report-392) ANALYTICAL METHOD FOR THE DISSOLUTION OF MISCELLANEOUS URANIC MATERIALS (OTHER THAN URANIUM METAL) FOR THE SPECTROGRAPHIC DETERMINATION OF CADMIUM, INDIUM AND MAGNESIUM. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1963. 4p.

Procedures for preparation of uranic compounds for spectrographic examination are described. Included are methods for UO_2 powder and pellets, and uranyl nitrate liquors. (J.R.D.)

14144 (PG-Report-400) ANALYTICAL METHOD FOR THE DETERMINATION OF CARBON IN URANIUM METAL. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1963. 14p.

Uranium metal, in the form of swarf or powder, is ignited at 950°C in an oxygen stream. Carbon dioxide evolved is isolated by means of a cold trap cooled in liquid oxygen and measured, after expansion at room temperature, as a gas volume. (auth)

14145 (PG-Report-410) ANALYTICAL METHOD FOR THE DETERMINATION OF TRACE THORIUM IN URANIUM METAL AND URANIUM COMPOUNDS. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1963. 6p.

The sample is dissolved in an acid mixture and thorium is separated from uranium by co-precipitation on lanthanum fluoride. Fluoride is largely removed by evaporation with nitric acid but residual traces are complexed using aluminum chloride solution. Thorium is determined absorptiometrically as the 'Thorin' complex. (auth)

14146 (PG-Report-411) ANALYTICAL METHOD FOR THE DETERMINATION OF OXYGEN IN URANIUM BY MICRO-PLATINUM BATH VACUUM FUSION. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1963. 13p.

A sample of the metal is reacted in molten Pt at 1900°C in a graphite crucible. Co, N_2, and H_2 evolved in the reaction are pumped off and analyzed. The O_2 is calculated from the CO volume. The method is applicable to samples from massive U metal. The lower limit of detection is 10 ppm O_2. (J.R.D.)

14147 (PG-Report-412) ANALYTICAL METHOD FOR THE DETERMINATION OF HYDROGEN AND OTHER GASES IN URANIUM AND OTHER REACTOR METALS BY HOT VACUUM EXTRACTION. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1962. 9p.

A sample of the metal is introduced, in vacuo, into a preheated furnace tube. The extracted gases are collected, their volume measured and analyzed for carbon dioxide, hydrogen, carbon monoxide, and nitrogen. The method can be used for the following metals: uranium, niobium, vanadium, nickel, iron, zirconium as metals, powders, or alloys. The method cannot be used for magnesium or other metals of similar volatility. Where hydrogen is the major component of the gas evolved, the standard deviation of a single determination is ±3% for a 25 g sample at a hydrogen level of 1 ppm by weight. The lower limit of detection is 0.005 ml N.T.P. of gas. For a 25 g sample, this is equivalent to 0.02 ppm hydrogen by weight. (auth)

14148 (PG-Report-416) ANALYTICAL METHOD FOR THE DETERMINATION OF TRACE AMOUNTS OF BUTEX IN AQUEOUS RAFFINATES (INFRARED ABSORPTION SPECTROMETRY). (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1963. 4p.

Butex is extracted into CCl_4 and the absorption at 1118 cm^{-1} is measured with an infrared spectrometer. The absorption at this wave length is ascribed to the C–O–C linkage. The concentration of Butex in the CCl_4 is obtained from a calibration curve. (J.R.D.)

14149 (PG-Report-419) THE ANALYSIS BY GAS CHROMATOGRAPHY OF HYDROGEN ISOTOPES AND MIXTURES CONTAINING HYDROGEN AND HELIUM. T. R. Phillips and D. R. Owens (United Kingdom Atomic Energy Authority. Production Group, Capenhurst, Ches., England). 1963. 13p.

A gas chromatographic method for the quantitative analysis of H, deuterium, and HD was developed employing columns packed with alumina coated with ferric oxide. Qualitative experiments show that the method could be extended to include mixtures containing tritium. The precision and accuracy of the method was influenced by the slow equilibration of adsorption processes within the columns, and it was found necessary to adopt standardized procedures for the introduction of samples. H_2 and He were separated on a column packed with Molecular Sieve 5A; no separation of He isotopes was observed. (auth)

14150 (TID-15842) THE USE OF INFRARED SPECTROSCOPY IN INORGANIC CHEMISTRY. John R. Ferraro (Argonne National Lab., Ill.). Apr. 1962. Contract [W-31-109-eng-38]. 11p. (UAC-6384)

A brief discussion of infrared spectroscopy uses in typical inorganic laboratories is presented. Information is included on spectroscopy of P compounds and ligand-metal bonds in nitrates. (J.R.D.)

14151 (AEC-tr-5637) ACTIVATION ANALYSIS WITH FAST NEUTRONS. Kakuzo Tada, Isao Fujii, Takeshi Adachi, and Kazuyuki Ogawa. Translated from p.538-41 of "Proceedings of the Fourth Japan Conference on Radioisotopes, held in Tokyo, October 10-12, 1961." 16p. (Includes original, 4p.).

An investigation was made on activation analysis using 14-Mev neutrons in order to study the feasibility of determining Pr in mixtures with La and Nd. The results for the analysis of Pr–La mixtures were generally good, but a positive bias was found in the analysis of Pr–Nd mixtures which is probably due to the Compton gamma continuum from Nd^{141}. (D.L.C.)

14152 (AEC-tr-5639) THE DETERMINATION OF GASEOUS TRITIUM COMPOUNDS WITH A PROPORTIONAL COUNTER. Akira Ono and Wataru Morimitsu. Translated from p.713-16 of "Proceedings of the Fourth Japan Conference on Radioisotopes, held in Tokyo, October 10-12, 1961." 15p. (Includes original, 4p.).

The use of a proportional counter made of glass for tritium counting was investigated with four counting gases: methane, propane, PR gas, and Q gas. The effects of filling gas pressure and counting gas purity and the memory effect on the counter response were studied. (D.L.C.)

14153 (CEA-tr-X-455) MÉTHODE DE DOSAGE RAPIDE DU MOLYBDÈNE DANS L'URANIUM MÉTALLIQUE. (Method of Rapid Determination of Molybdenum in Metallic Uranium). Morimoto and Ashizawa. Translated into French from Bunseki Kagaku, 10: 532-3(1961). 4p.

A method for the fast and simple determination of Mo in metallic U at Mo concentrations from 0.5 to 15 ppm was described. The sample is decomposed by hydrochloric acid and hydrogen peroxide. The Mo is reduced in the presence of the U with stannous chloride. Ammonium thiocyanate is the colorimetric reagent. After extraction with n-butyl acetate, the Mo is determined by measuring the absorption at 470 mμ. The effect of various parameters on the determination is examined. (J.S.R.)

14154 (CEA-tr-X-485) MÉTHODE DE SÉPARATION DU STRONTIUM ET DU CÉSIUM SUR UNE RÉSINE

ÉCHANGEUSE D'IONS. MÉTHODE D'ANALYSE DES PRODUITS RADIOACTIFS ARTIFICIELS DANS L'EAU DE PLUIE ET DANS DES RETOMBÉES DE POUSSIÈRES. (Method of Separation of Strontium and Cesium on Ion Exchange Resins. Method of Analysis of Artificial Radioactive Products in Rain Water and in Fallout Dusts). Hiroyuki Tsubota. PRECAUTIONS A PRENDRE CONTRE L'IRRADIATION NUCLEAIRE A L'ADRESSE DES INGENIEURS CHIMISTES. (Precautions to be Taken Against Nuclear Radiation by the Chemical Engineer). Shôkichi Sakagishi. Translated into French from Bunseki Kagaku, 9: 905-9; 910-15(1960). 59p.

I. A simultaneous method for the separation of strontium and cesium by ion exchange and precipitation is described. This method utilizes classical precipitation to eliminate the Fe and Al and ion exchange resins to separate the Ca and Sr. No carrier is necessary in this method in opposition to the requirements of the classical method. The analysis of artificial radioactive products in rain water and in fallout dust requires a method of great precision. A brief summary is given of the methods for the preparation of the sample to be analyzed and for the measurement of Sr^{90} and Cs^{137}. II. The basic concepts and the indispensable ideas concerning the manipulation of radioactive substances by persons in chemical research with radioisotopes are briefly summarized. The characteristics of accidents caused by nuclear radiation are described. The permissible dose and the permissible level for surface contamination are given. The radioactive threshold of the laboratory storage is discussed. Equipment necessary to ensure safe handling, storage, and transportation of radioisotopes is reviewed. The steps to be taken in case of radiation exposure are tabulated. (J.S.R.)

14155 TRI-n-OCTYLAMINE AS LIQUID ANION EXCHANGER FOR CHROMATOGRAPHIC SEPARATION OF RARE EARTHS ON PAPER OR CELLULOSE POWDER. Corrado Testa (Centro Informazioni Studi Esperienze, Milan). Anal. Chem., 34: 1556-9(Nov. 1962).

The chromatographic behavior of rare earths on paper treated with tri-n-octylamine (TNOA) by elution with $LiNO_3$ solutions was investigated. Rare earths form anionic nitric complexes whose strength increases with decrease of atomic number. By plotting log $(1/R_F - 1)$ vs the atomic number of the rare earths, a straight line was obtained, which indicates a mean separation factor of 1.45 for two adjacent elements. The influence on R_F values of the concentration of $LiNO_3$ eluting solution and of TNOA treating solution, and the HNO_3 added to $LiNO_3$, was also studied. Some examples of the separation of three or four rare earths are reported, and the possibility of separating milligram quantities of rare earths on beds of cellulose powder treated with TNOA is shown. (auth)

14156 SOLVENT EXTRACTION METHOD FOR THE RADIOCHEMICAL DETERMINATION OF CHROMIUM. William J. Maeck, Maxine E. Kussy, and James E. Rein (Phillips Petroleum Co., Idaho Falls, Idaho). Anal. Chem., 34: 1602-4(Nov. 1962).

A procedure for the separation of radioactive chromium from fission and stainless steel corrosion products is based on extraction of the chromium (VI) tetrabutylammonium ion-association complex into methyl isobutyl ketone. The yield is determined spectrophotometrically and the counting is done in a well-type NaI(Tl) scintillation crystal. Precision based on replicate analysis of a chromium-51 solution is 1% coefficient relative standard deviation. (auth)

14157 PLUTONIUM SULFATE TETRAHYDRATE, A PROPOSED PRIMARY ANALYTICAL STANDARD FOR PLUTONIUM. Charles E. Pietri (U. S. Atomic Energy Commission, New Brunswick, N. J.). Anal. Chem., 34: 1604-6(Nov. 1962).

Stoichiometric plutonium sulfate tetrahydrate has been prepared by controlled crystallization from sulfuric acid solution. The formula of the tetrahydrate was found by chemical and thermogravimetric analysis to be $Pu(SO_4)_2 \cdot 4H_2O$. The compound is stable, showing no significant change in plutonium content or weight for at least 28 months. Changes in relative humidity below 75% had little effect on the material. The plutonium sulfate tetrahydrate prepared meets many of the requirements for a primary standard. (auth)

14158 DETERMINATION OF TANTALUM IN TUNGSTEN BY ACTIVATION ANALYSIS. Richard Corth (Westinghouse Electric Corp., Bloomfield, N. J.). Anal. Chem., 34: 1607-8(Nov. 1962).

Tantalum determination in tungsten by activation analysis is presented. The method specifically covers the concentration range of 0.1 to 10% tantalum, although the technique is not restricted to this range and can be used for both higher and lower concentrations. The technique requires no chemical manipulations. (auth)

14159 DETERMINATION OF GASEOUS FLUORINE USING RADIOACTIVE CLATHRATES. Carlton O. Hommel, Frederick J. Brousaides, and Richard L. Bersin (Tracer Lab., Inc., Waltham, Mass.). Anal. Chem., 34: 1608-10 (Nov. 1962).

A radiometric method for the detection of parts per million concentrations of gaseous fluorine utilizing the interaction with Kr^{85}–quinol clathrate is described. The system employing conventional counting techniques can readily be incorporated into a device for routine gas monitoring. (auth)

14160 RAPID, NONDESTRUCTIVE DETERMINATION OF BERYLLIUM USING VAN DE GRAAFF X-RAYS. Charles A. Levine and Joseph P. Surls, Jr. (Dow Chemical Co., Pittsburg, Calif.). Anal. Chem., 34: 1614-17(Nov.1962).

A method is described for the rapid nondestructive analysis for beryllium utilizing the well known $Be^9(\gamma,n)2\alpha$ reaction. The γ rays were produced by conversion in a tungsten target of electrons accelerated by a Van de Graaff machine. Some of the neutrons resulting from the reaction of the γ rays with beryllium were captured in a silver disk to produce radioactive silver isotopes. The induced radioactivity was counted with a Geiger-Müller tube apparatus and was proportional to the beryllium content of the irradiated sample. The average time required for a determination was 4 minutes. With a 20-gram sample, the limit of detection in a single determination was 0.002%. (auth)

14161 DETERMINATION OF OXYGEN IN MIXED FLUORIDES BY INERT GAS FUSION. J. Leon Potter, James E. Murphy, and Howard H. Heady (Bureau of Mines, Reno, Nev.). Anal. Chem., 34: 1635-8(Nov. 1962).

An inert gas fusion procedure is described for determining oxygen in mixed fluoride electrolytes used in electrowinning uranium and the rare earth metals. The main factors discussed are the temperature required to remove oxygen quantitatively from various fluorides, a water and acid trap to entrain the volatilized fluorides, a sample preparation technique for heterogeneous fluorides, and use of a dry crucible instead of a platinum flux. Relative error of the method in the 0.05 to 0.5% range is about 5%. (auth)

14162 SOLVENT EXTRACTION METHOD FOR ZIRCONIUM-97. USE FOR EVALUATING CRITICAL

NUCLEAR INCIDENTS. William J. Maeck, S. Fredric Marsh, and James E. Rein (Phillips Petroleum Co., Idaho Falls, Idaho). Anal. Chem., 35: 292-4(Mar. 1963).

On the basis of experience with three incidents in which large levels of fission products were present prior to the incidents, three fission product nuclides, Mo^{99}, Ce^{143}, and Zr^{97}, are recommended as monitors. A method is described for Zr^{97} based on TTA extraction of zirconium activity followed by milking and counting of the Nb^{97} daughter activity. Relative standard deviation is 1.1%. (P.C.H.)

14163 SPECTROPHOTOMETRIC DETERMINATION OF TECHNETIUM WITH 1,5-DIPHENYLCARBOHYDRAZIDE. F. J. Miller and H. E. Zittel (Oak Ridge National Lab., Tenn.). Anal. Chem., 35: 299-301(Mar. 1963).

A method was developed for the spectrophotometric determination of Tc(VII) in the microgram-per-milliliter range by reaction with 1,5-diphenylcarbohydrazide (DPC) in 1.5 M H_2SO_4. Thirty-five minutes are required for maximum development of color, and the absorbance is measured at 520 mμ within an hour. The mechanism of the Tc–DPC reaction is the reduction of Tc(VII) to Tc(IV) by 1,5-diphenylcarbohydrazide and subsequent complexation of Tc(IV). When both Cr(VI) and Tc(VII) are present, the colors produced by their reactions with DPC develop simultaneously. The Tc–DPC complex is extractable into CCl_4; the Cr–DPC chromophore is not. The absorbance of the organic phase can be used to determine technetium and that of the aqueous phase to determine chromium. The molar absorptivity of the Tc–DPC complex is 48,600. The relative standard deviation of the method is about 2%. The ions VO_4^{3-}, MoO_4^{2-}, ReO_4^-, and Hg^{2+} interfere slightly; Fe^{3+}, CrO_4^{2-}, and Ce^{4+} interfere strongly. (auth)

14164 USE OF A LEAD REDUCTOR IN THE POTENTIOMETRIC DETERMINATION OF URANIUM AND IRON. W. R. Amos and W. B. Brown (Monsanto Research Corp., Miamisburg, Ohio). Anal. Chem., 35: 309-11(Mar. 1963).

Iron and U were determined simultaneously by potentiometric titration with potassium dichromate. The samples were passed through a Pb reductor into sufficient potassium dichromate to oxidize 95% of the estimated U in the sample. After the resulting solution was purged with Ar and heated to 85 to 95°C, the remaining 5% of the uranium(IV) was titrated. The potential break occurred between +260 and +300 mv vs the saturated calomel electrode. After the uranium(IV) was oxidized, iron(II) was titrated with dichromate. The potential break occurred between +660 and +700 mv vs the saturated calomel electrode. The results were accurate to ±0.35%. Interferences included Ti, V, As, Mo, Sn, and Sb. (auth)

14165 A NEW SPECTROPHOTOMETRIC REACTION OF BERYLLIUM. A. M. Cabrera and T. S. West (Univ. of Birmingham, Eng.). Anal. Chem., 35: 311-13(Mar. 1963).

A highly sensitive method is described for the spectrophotometric determination of Be in the range 0.01 to 7 ppm. The color reaction between the reagent Fast Sulphon Black F and Be is specific at pH 11 to 11.2 in the presence of EDTA and KCN among some 25 cations examined. Fluoride, citrate, and tartrate do not interfere and a 10-fold amount of phosphate can be tolerated. The only cations that tend to interfere are chromium(III) and tin(II), and these can be rendered harmless by previous oxidation to their higher valency forms. The stability, sensitivity, and freedom from interference of the proposed method compare favorably with those of standard methods now in use. (auth)

14166 OXYGEN-18 DETERMINATION BY COUNTING DELAYED NEUTRONS OF NITROGEN-17. Saadia Amiel and Max Peisach (Israel Atomic Energy Commission, Rehovoth). Anal. Chem., 35: 323-7(Mar. 1963).

Neutron counting of 4.14-sec N^{17} was used for the analysis of O^{18} in solutions containing known amounts of Li^6. Nitrogen-17 is produced by the successive nuclear reactions $Li^6(n,\alpha)t$; $O^{18}(t,\alpha)N^{17}$ on irradiation with thermal neutrons. The total delayed neutron emission of a sample irradiated to saturation at a thermal neutron flux of 10^{13} n/cm²-second is about 4×10^5 neutrons per mg of Li^6 per atom per cent O^{18}. The N^{17} formation is proportional to the atom fraction of O^{18} and is independent of the sample size. (auth)

14167 ON THE REACTIVITY AND POSSIBLE ANALYTICAL APPLICATIONS OF IMIDO-DIOXIMES. I. PHTHALIMIDO-DIOXIME (1,3-DIHYDROXIMINO ISOINDOLINE) AND SUCCINIMIDO-DIOXIME (2,5-DIHYDROXIMINO PYRROLIDINE). F. Buscaróns and J. Abelló (Universidad, Barcelona). Anales Real Soc. Espan. Fis. Quim. (Madrid), Ser. B, 58: 591-600(Sept.-Oct. 1962). (In Spanish)

The reactivity of phthalimido-dioxime (1,3-dihydroximino isoindoline) and of succinimido-dioxime (2,5-dihydroximino pyrrolidine) with inorganic ions is described, and the sensitivities of their more important reactions are reported. The more remarkable ones are: for phthalimido-dioxime with Mn^{2+} ($1:10^7$), Pd^{2+} ($1:5 \times 10^6$), Ni^{2+} ($1:4 \times 10^6$), Co^{2+} ($1:3 \times 10^6$), UO_2^{2+} ($1:10^6$), and Tl^{3+} ($1:10^6$); and for succinimido-dioxime with Fe^{3+} ($1:2 \times 10^6$), Mn^{2+} ($1:2 \times 10^6$), UO_2^{2+} ($1:5 \times 10^5$), and Co^{2+} ($1:7.5 \times 10^5$). The latter gives a reaction, probably catalytic, with Mn^{2+} which reaches a sensitivity of $1:10^7$. (auth)

14168 GAMMA-RAY SPECTROMETRIC DETERMINATION OF LOW CONCENTRATIONS OF RADIOACTIVE CAESIUM IN SEA WATER BY A NICKEL FERROCYANIDE METHOD. G. J. Mohanrao (California Inst. of Tech., Pasadena) and T. R. Folsom. Analyst, 88: 105-8(Feb. 1963).

A simple, fairly rapid and reliable method is presented for determining radioactive caesium in sea water, based on a known method of concentration. Radioactive caesium, together with microgram amounts of stable caesium naturally present in sea water, is co-precipitated with nickel ferrocyanide from a 50- to 200-liter sample. After the precipitate has settled and the supernatant liquid has been syphoned off, the nickel ferrocyanide is transferred to a pint container and counted in a gamma-ray spectrometer equipped with a 5-inch × 4-inch NaI(Tl) crystal and 256-channel pulse-height analyser. Studies with a caesium-134 tracer helped to determine the most favorable conditions of pH, temperature, and concentration of reagent. The procedure has been used aboard ship and in the laboratory since 1960 for oceanographic survey of radioactive caesium in sea water in concentrations ranging between 0.03 and 0.4 pc per liter. (auth)

14169 THE DETERMINATION OF SCANDIUM IN URANIUM COMPOUNDS BY SOLVENT EXTRACTION WITH 2-THENOYLTRIFLUOROACETONE. Allan W. Ashbrook (Eldorado Mining and Refining Ltd., Ottawa). Analyst, 88: 113-16(Feb. 1963).

A method is described for determining scandium in uranium compounds. In the proposed procedure scandium is separated from interfering elements by extraction into a 0.2 M solution of 2-thenoyltrifluoroacetone in xylene. The scandium is then separated from the organic phase

with nitric acid and determiped spectrophotometrically as the red-brown colored scandium-alizarin complex. Of the elements usually found in uranium compounds, only copper interferes. (auth)

14170 THE DETERMINATION OF TANTALUM AND NIOBIUM IN HIGH-GRADE MINERALS AND ORES. H. W. Webb, V. Ashworth, and J. M. Hills (Johnson, Matthey and Co. Ltd., Wembley, Middx., Eng.). Analyst, 88: 142-4 (Feb. 1963).

A relatively rapid method is proposed for determining Ta and Nb in minerals and ores. The method is based on Schoeller and Powell's method for the separation of Ta and Nb from the ore, and on the spectrophotometric measurement of their pyrogallol complexes. The amounts of Ta and Nb are read off from the calibration graphs for known mixtures of Ta_2O_5 and Nb_2O_5. (D.L.C.)

14171 ACTIVATION ANALYSIS. H. A. Das. Atomenergie Haar Toepassingen, 4: 295-7(Nov. 1962). (In English)

An outline is given of the fundamentals of activation analysis. Apparatus, methods of calculation, sources of error, and some particular problems associated with activation analysis are discussed. A reactor facility for activations is described. (T.F.H.)

14172 SEPARATION OF RADIOACTIVE CALCIUM AND STRONTIUM BY PAPER CHROMATOGRAPHY. Pierre Lerch and Maurice Cosandey (Université, Lausanne, Switzerland). Chimia (Switz.), 16: 416-18(Dec. 15, 1962). (In French)

For the separation of calcium and strontium, a method of paper chromatography was tested using the radioactive indicators Ca^{45} and Sr^{89}. The isopropanol-NH_4CNS-water system was used. The variations of R_f and of the radioactive peaks before and after the chromatogram development were studied in connection with the amount of inactive elements present, from carrier-free solutions to mg quantities of $CaCl_2$ and $SrCl_2$. The R_f only varies with the amount of carrier. (auth)

14173 CHEMICAL ANALYSIS OF STAINLESS STEEL CORROSION PRODUCTS. A REPORT OF NACE TECHNICAL UNIT COMMITTEE T-3B ON CORROSION PRODUCTS. J. R. Ciaranello and K. E. Combs (Knolls Atomic Power Lab., Schenectady, N. Y.). Corrosion, 19: 113t-14t(Mar. 1963).

To combat corrosion successfully, a knowledge of the mechanisms involved in corrosion processes is essential. To investigate these mechanisms, chemical analyses of corrosion products must be made. In many cases, a very small amount of sample is available, so what amounts to a trace analysis has to be performed. A brief outline is presented of certain analytical procedures that have been applied in detecting small quantities of iron, nickel, chromium, manganese, cobalt, zirconium, copper, and zinc. The accuracy of each method is indicated. (auth)

14174 A NEW RAPID METHOD FOR DETERMINING Sr^{90} CONTENT IN BONE. M. M. Golutvina, T. A. Kozakova, Yu. M. Nikolaev, and N. V. Markelova. Federation Proc., Transl. Suppl., 22: No. 1, Pt. II, T144-7(Jan.-Feb. 1963).

A method is described for determining the Sr^{90} content in human and animal bones. The method is based on the preferential extraction of equilibrium Y^{90} by tributyl phosphate from a nitric acid solution of bone tissue ash. This method permits completion of 2 to 4 analyses in one working day. The proposed method makes it possible to discontinue the use of fuming nitric acid for separating calcium from strontium. This is an important advantage where serial analyses must be carried out. In contrast to the precipitation methods now in use, the new procedure permits determination of the yield on the basis of carrier; hence, it gives more accurate results. Where necessary, the proposed method can be used to isolate Y^{90} from a solution of bone ash in the absence of a carrier. (auth)

14175 AN ALL-METAL SPECTROMETER FOR THE ISOTOPIC ANALYSIS OF HYDROGEN AT NATURAL CONCENTRATION LEVELS. P. V. Krishna Murthy and B. S. Prahallada Rao (Atomic Energy Establishment, Trombay, India). Indian J. Pure Appl. Phys., 1: 73-9(Feb. 1963).

The design and constructional details of an all-metal, double collector type mass spectrometer in which the pole faces form part of the analyser are described. The spectrometer has the advantage of ruggedness and easy demountability of the ion source for replacement of filament and for cleaning purposes. The design also provides a simple and perfect arrangement for shielding the electrometers and hi-meg resistors. A negative shield behind the filament in the ion source improves the efficiency of the ionizing electron beam. The use of normal slits instead of slant slits on the collector side leads to a reduction in the sizes of the collector slits and the collector cups, resulting in reduced pickups and easier mounting arrangement. The stabilities of H_3^+ formation and the operation of the instrument in the routine isotopic analysis of hydrogen over long periods are comparable to those of the existing glass spectrometers. With this instrument samples could be compared to a precision of 0.0001 mole % deuterium. Percentage differences of samples checked over an interval of 3 to 4 months were found to be reproducible to a precision of ±1%. (auth)

14176 CHROMATOGRAPHY ON PAPER IMPREGNATED WITH ION-EXCHANGE RESINS. VII. ION EXCHANGE WITH ORGANIC SOLVENTS. M. Lederer, V. Moscatelli, and C. Padiglione (Consiglio Nazionale delle Ricerche, Rome and Comitato Nazionale per l'Energia Nucleare, Rome). J. Chromatog., 10: 82-92(Jan. 1963). (In English)

The adsorption of a number of metal ions from organic solvents (such as methanol, ethanol, isopropanol, acetone) mixed with acids (such as HCl, HNO_3, or H_2SO_4) was studied on cellulose paper, zirconium phosphate-impregnated paper, sulphonic resin paper, and quaternary ammonium resin paper. As the mechanisms responsible for the adsorption the following were suggested: ion exchange, complex formation with the groups of the exchangers, partition with the water held on the paper, adsorption on the organic network of the paper or resin, and change of the complex equilibria due to the presence of the organic solvent. (auth)

14177 ION-EXCHANGE PAPER CHROMATOGRAPHY OF LANTHANIDE IONS. I. ANION EXCHANGE OF LANTHANIDE CITRATE COMPLEXES. R. Arnold and Jane F. Ritchie (Univ. of Cape Town, S. Africa). J. Chromatog., 10: 205-11(Feb. 1963). (In English)

The application of cellulosic anion-exchange papers to the separation of tracer amounts of rare earths was investigated, using citric acid solutions as eluents. It was found most satisfactory to use diethylaminoethyl-cellulose paper with 0.026 M citric acid (pH 2.4) as eluent. Under these conditions a practical separation factor of 2.6 between europium and cerium was obtained. Slightly higher separation factors could be obtained by adding ethanol to the citric acid solutions. (auth)

14178 QUANTITATIVE INORGANIC CHROMATOGRAPHY. PART IX. THE ANALYSIS OF ALKALINE-

EARTH METALS BY ION-EXCHANGE CHROMATOGRAPHY AND FLAME SPECTROPHOTOMETRY. F. H. Pollard, G. Nickless, and D. Spincer (Univ. of Bristol, Eng.). J. Chromatog., 10: 215-20(Feb. 1963). (In English)

An ion-exchange chromatographic procedure is described for quantitative analysis of μg/mg amounts of barium, calcium, magnesium, and strontium. After elution, the metals are determined by flame spectrophotometry. (auth)

14179 HIGH-VOLTAGE PAPER ELECTROPHORESIS OF INORGANIC CATIONS. CONDITIONS FOR CATHODIC MIGRATION AND MEASUREMENT OF MIGRATION RATES. D. Gross (Tate and Lyle Refineries Ltd., Keston, Kent, Eng.). J. Chromatog., 10: 221-30(Feb. 1963). (In English)

Conditions were investigated under which most inorganic cations are non-complexed and migrate at varying rates toward the cathode. A background electrolyte consisting of a 0.75 M formic acid solution of pH 2.0 was found particularly suitable for this purpose. Another electrolyte solution, viz. an approx. 0.1 M ammonium carbonate solution of pH 8.9 was again thoroughly investigated for the migration behavior of many cations. The measured migration rates were tabulated and mobilities calculated and compared. A new tortuosity effect was observed. All measurements were made using a previously described high-voltage apparatus of ample precision ensuring good reproducibility of results. (auth)

14180 AMPEROMETRIC TITRATION OF LANTHANUM BY FERROCYANIDE. J. N. Gaur and K. Zutshi (Univ. of Rajasthan, Jaipur, India). J. Electroanal. Chem., 5: 208-10(Mar. 1963). (In English)

Lanthanum nitrate solutions were titrated with a standard solution of potassium ferrocyanide at the dropping mercury electrode at a potential of −1.58 v. The two solutions react in the ratio of I:I with the formation of the compound $LaKFe(CN)_6$. Amperometric titration of $La(NO_3)_3$ and $K_4Fe(CN)_6$ affords a sensitive method for the estimation of lanthanum. (auth)

14181 RAPID NON-DESTRUCTIVE ANALYSIS FOR GOLD IN COPPER–GOLD MIXTURES BY NEUTRON ACTIVATION. Minoru Okada (Government Chemical Industrial Research Inst., Tokyo) and Yuichiro Kamemoto. Nature, 197: 278-9(Jan. 19, 1963).

An 11.95-mg mixture of copper-gold was neutron irradiated at a flux of 3×10^{11} n/cm^2/sec and counted using a well-type sodium iodide crystal attached to a 256-channel pulse-height analyzer. From both γ energy and half life, gold was identified on the basis that, in the half-life range $1-10^2$ sec, there is no other nuclide having nearly the same γ energy as gold-197. (H.G.G.)

14182 RAPID MICRODETERMINATION OF INDIUM BY NEUTRON ACTIVATION. Minoru Okada (Government Chemical Industrial Research Inst., Tokyo) and Yuichiro Kamemoto. Nature, 197: 279(Jan. 19, 1963).

A 43.5 mg sample of zinc blend was neutron irradiated at a flux of 3×10^{11} n/cm^2/sec, and the activated γ rays were counted. The half life of the nuclide formed is determined from successive spectra obtained. From both γ energy and half life, indium can be identified on the basis that, except indium-116, there is no nuclide formed in the pile-neutron irradiation, which emits a γ ray of ~0.15 Mev with a half life of 1 ~ 10 sec. (H.G.G.)

14183 NEUTRON ACTIVATION ANALYSES OF SNAKE VENOMS: PRESENCE OF COPPER. S. Gitter (Univ. of Tel-Aviv, Israel and Beilinson Hospital, Petah-Tikva, Israel), S. Amiel, G. Gilat, T. Sonnino, and Y. Welwart. Nature, 197: 383-4(Jan. 26, 1963).

Neutron activation analysis was used to demonstrate the presence of Cu in snake venoms. Attempts to detect an increase in the Cu concentration of various mouse tissues after introduction of venom were unsuccessful. (C.H.)

14184 ACTIVATION ANALYSIS OF PAPER CHROMATOGRAMS FOR IODINE ($^{127}I \rightarrow {}^{128}I$). Alice Dimitriadou, P. C. R. Turner, and T. Russell Fraser (Postgraduate Medical School and Medical Research Council Cyclotron Unit, London). Nature, 197: 446-9(Feb. 2, 1963).

A procedure is described for the direct activation analysis of paper chromatograms prepared from extracts of human sera for $I^{127} \rightarrow I^{128}$. Iodine^{128} was produced by an (n,γ) reaction on I^{127} after exposure to a thermal neutron beam. Stringent post-irradiation purification was required to eliminate from the sample the other more active radiochemical products also activated in the paper. The sensitivity of activation analysis was compared with that of the ceric-arsenite method for the detection of iodine compounds on paper chromatograms. It was concluded that activation analysis should be used as a useful check of the ceric-arsenite method. (C.H.)

14185 ASSAY OF TRITIUM, CARBON-14 AND SULPHUR-35 IN WOOL BY LIQUID-SCINTILLATION COUNTING. A. M. Downes and A. R. Till (Commonwealth Scientific and Industrial Research Organization, Prospect, N. S. W., Australia). Nature, 197: 449-50(Feb. 2, 1963).

A procedure is described for the assay of biosynthetically labeled wool directly by the liquid scintillation method. Results are reported for the assay of samples clipped from three sheep that had received intravenous injections of H^3-lysine, C^{14}-phenylalanine, or S^{35}-cystine respectively. (C.H.)

14186 ACTIVATION ANALYSIS OF PARTICULATE AIR CONTAMINANTS. Thomas F. Parkinson and Louis G. Grant (Univ. of Florida, Gainesville). Nature, 197: 479-80 (Feb. 2, 1963).

A procedure is described for the activation analysis of particulate air contaminants collected on filter papers. Results are included from the identification of several radioactive species in a series of samples. The samples, together with a filter paper control, were irradiated in a reactor. Measurements of β activity were made with a proportional counter and γ activities were measured with a pulse height analyzer equipped with a scintillation detector. Some samples were also analyzed with a multichannel analyzer. Data are included on the activation history of the samples and the radioisotopes identified. (C.H.)

14187 QUANTITATIVE DETERMINATION OF OXYGEN-18 BY ACTIVATION ANALYSIS. Donald E. Solberg, John A. Wethington, Jr., and Thomas F. Parkinson (Univ. of Florida, Gainsville). Nature, 197: 611-12(Feb. 9, 1963).

Measurements show that the determination of O^{18} and O^{18}/O^{16} ratios by activation analysis of biological materials following exposure to reactor neutrons is practical. The method is recommended for oxygen metabolism studies in living systems. Since radioactivity is introduced after both the experiment and subsequent separations are completed, results are not obscured by possible effects of ionizing radiation on the system under investigation. (C.H.)

14188 DETERMINATION OF IMPURITIES BY NEUTRON ACTIVATION ANALYSIS. II. DETERMINATION OF Ar IN AIR, He AND Cu BY NEUTRON ACTIVATION ANALYSIS. Yuichiro Kamemoto (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gokkaishi, 5: 48-51 (Jan. 1963). (In Japanese)

Neutron activation analysis was applied to the determination of argon in air, helium, and copper metal. Air and helium samples were sealed in polyethylene tubes and irradiated simultaneously with argon standard in the JRR-1 reactor at a neutron flux of about 3×10^{11} n/cm^2/sec for 20 min. After the irradiation, they were mounted in a 3 × 3 in. sodium iodide crystal attached to a RCL 256 channel pulse height analyzer. Argon was determined by γ ray spectrometry, comparing the height of photopeak at 1.29 Mev γ of samples with that of standard. Argon in copper metal was determined by means of radiochemical separation and γ ray spectrometry. A copper sample was irradiated simultaneously with argon standard in the JRR-1 reactor for 2 hr. The irradiated sample was dissolved in diluted HNO_3 in helium atmosphere and argon was absorbed in a charcoal trap cooled with liquid nitrogen. Argon collected in the trap was determined by γ ray spectrometry. (auth)

14189 DETERMINATION OF MICROQUANTITIES OF NEPTUNIUM WITH ARSENAZO III REAGENT. E. G. Chudinov and G. N. Yakovlev. Radiokhimiya, 4: 506-8 (1962). (In Russian)

Determination of microquantities of Np in the presence of large quantities of U and Pu was based on solvent extraction of U and Pu by di-2-ethylhexyloxylorthophosphoric acid from Np^{5+} followed by determination of Np^{4+} by arsenazo(III) in 4M nitric acid. The sensitivity is 0.04 γ/ml. (R.V.J.)

14190 POLAROGRAPHIC DETERMINATION OF URANIUM IN ORES AND MINERALS. L. N. Lyubimova and V. G. Sochevanov. Radiokhimiya, 4: 701-6(1962). (In Russian)

The variable valency of U makes it possible to determine it by polarographic methods; the $UO_2^{2+} + e = UO_2^+$ reaction is of special interest in this respect. A method was developed for such determination, using a nitric–ascorbic acid solution which contained up to 0.25M HNO_3, 1M NH_4NO_3; and 0.05M ascorbic acid at a pH between 3 and 4. It was found that the Ilkovič equation is valid within the U concentration range from 0.01 to 2.0 g/ml. The results of the polarographic determination are affected by the presence of certain elements, such as Cu, Bi, Pb, Tl, Se, Te, Ti, V, Sb, Mo(VI), and As(V) which must be eliminated from the solution by adsorption on silica gel. The size of the sample needed for a determination ranged from 0.1 to 1 g, depending on the U content. A check of the results obtained by chemical analysis confirmed the reliability of the polarographic method, which was used with good success to the analysis of ores and minerals with U contents ranging from a few hundreths of 1% to 82% (pure oxide). Ten specimens may be analyzed within 2 days. (TTT)

14191 THE EFFECT OF ACTINON AND RADON ON THE DETERMINATION OF THORON BY THE EMANATION METHOD. P. I. Chalkin and N. V. Golubev. Radiokhimiya, 4: 742-4(1962). (In Russian)

The problem of the influence of Ra^{226} and Ra^{223} on Rn^{220} measurements was investigated with an ionization chamber. It was found that an increase of Ra^{226} and of the Ra^{223} in relative equilibrium with it cause a nearly directly proportional increase in the activity recorded by the ionization chamber. No effect was noted if the Ra^{226} concentration was kept below 1×10^{-9} g. An equilibrium solution containing 4×10^{-8} g Ra^{226} and a solution containing 3.52×10^{-3} g Th^{232} were used for the emanation tests, passing the gas through a 1-liter chamber at flow rates ranging from 0.35 to 1.10 liter/min. Changing the flow rates between 0.6 to 0.8 liter/min did not cause a noticeable effect, although the activity changed noticeably. Thus, if the effect of actinon and radon must be taken into account, the flow rate must be kept constant. An increase of the Ra^{223} and Ra^{226} concentrations resulted in the decrease of the accuracy of the measurements which became dependent on the amount of Ra^{224} present. (TTT)

14192 PHOTOMETRIC DETERMINATION OF Th, U, Zr, Pa, Sc, AND RARE EARTH ELEMENTS. S. B. Savvin (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). Zavodsk. Lab., 29: 131-9(1963). (In Russian)

Photometric determination of Hf, Pa, Sc, Th, Zr, and U(IV) using arsenazo(III), without separating admixtures is described. The color reactions with arsenazo(III) and the light absorption as a function of ionic radius are tabulated. (R.V.J.)

14193 FLUORESCENCE DETERMINATION OF Nb BY LUMOGALLION IREA. V. V. Klimov and O. S. Didkovskaya (All-Union Research Inst. of Chemical Reagents, USSR). Zavodsk. Lab., 29: 147-8(1963). (In Russian)

Lumogallion IREA (2.2', 4'-trioxy-5-chlor-(1-azo-1')-benzene-3-sulfo acid) and 0.1 to 2.5 μg/ml of niobium form a fluorescent compound with a constant color intensity even in the presence of 30 fold Ta saturation. The sensitivity of the reaction is 1.0 μg Nb/10 ml of solution. (R.V.J.)

14194 ANALITICHESKAYA KHIMIYA URANA. (Analytical Chemistry of Uranium). A. R. Vinogradov, ed. Moscow, Izdatel'stvo Akademii Nauk SSSR, 1962. 431p.

A survey is given of uranium properties and physicochemical determination. Complex U(IV) compounds, uranyl ions, and uranium in solutions are analyzed, and quantitative and qualitative methods for determination are described. Radiometric determination of U in rock and ores is also considered. 1093 references are included. (R.V.J.)

14195 COLORIMETRIC DETERMINATION OF ZIRCONIUM WITH PYROCATECHIN VIOLET. Tsu-chen Ch'eng, We-ying Wang, and Ch'yu-wu P'ang. p.101-7 of "Khimicheskie, Fiziko-Khimicheskie i Spektroskopicheskie Metody Issleodovaniya Rud Redkikh i Rasseyanykh." Moscow, Gosgeoltakhizdat, 1961.

A method for the colorimetric analysis of Zr for Zr contents in aliquot parts of <600 γ is given. A 0.2-g sample is melted together with 1 g each of Na_2CO_3 and Na_2O_2 at 600 to 620°C for 15 min. The melt is leached out with water and the solution filtered. The filter with the precipitate is leached; 30 ml of HCl (2:1) and 2 ml of 30% H_2O_2 are added and the solution is boiled, cooled, transferred to a 100-ml retort, and diluted with water. 10 ml of the top layer is poured off, 1 g of NH_4Cl is added, and the mixture is neutralized with NH_4OH. After the appearance of precipitate, excess NH_4OH and 3 ml of paper pulp are added. The product is filtered through a dense filter. The filtrate and wash water are collected, a 15% solution of trilon and 1 drop of bromcresol violet are added, and the mixture is neutralized with HCl and NH_4OH until the indicator becomes bright yellow. A 50% solution of CH_3COONH_4 and HCl are added, and, after 10 min, a 0.05% solution of pyrocatechin violet. The mixture is diluted with water and colorimetered after 3 hr. The correction for Ti is determined, and the solution's optical density corresponding to the Ti content obtained is found from a correction curve. The optical density corresponding to the Ti content is subtracted from the value of the solution's optical density found during colorimetry of Zr. The difference is used as the optical density value for the determination of Zr from a standard curve. (P.C.H.)

14196 THE DETERMINATION OF OXYGEN IN LITHIUM. R. J. Jaworowski, J. R. Potts, and E. W. Hobart (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). 30p. (TID-17920)

To be published in TID-7655 Proceedings of the Sixth Symposium on Analytical Chemistry in Nuclear Reactor Technology, held in Gatlinburg, Tenn., October 11, 1962.

A method is proposed for the determination of O_2 in Li and in other alkali metals involving solution of the metal in liquid ammonia followed by filtration and titration of insoluble oxides. Quantitative retention of the oxides by fritted glass filters is demonstrated by the agreement of results obtained using coarse-, medium-, and fine-porosity filters. N_2, dissolved in Li samples, is not retained by the filter as indicated by analysis of the residues. Titration curves almost always reveal the presence of carbonate in the solution of the residues in an amount approximately equivalent to the total C content of the Li as determined by the combustion method. This observation, coupled with the previously observed fact that C in Li ordinarily forms carbonate when samples are dissolved in water, leads to further speculation regarding the form of C dissolved in Li. Various methods for handling Li samples prior to analysis are discussed as is validation of the method by recovery of known additions of O_2 to Li and by comparison of results with the amalgamation method when applied to Na, K, and Cs. (auth)

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Refer also to abstracts 15231, 15232, and 15245.

14197 (AERE-R-4114) REMOVAL OF IODINE VAPOUR FROM AIR BY METALLIC COPPER. J. B. Morris, R. A. Stinchcombe, M. D. Gray, and D. H. Logsdail (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Oct. 1962. 81p.

The adsorption of iodine vapor by metallic copper was studied under dynamic and static conditions at ambient temperature. In the dynamic experiments two types of wire mesh and a ring packing were used. Inlet iodine concentrations of 0.5 $\mu g/m^3$ to 50 mg/m^3, inlet loadings of up to 10^4 monolayers, and air velocities of 1 to 17 ft/sec were employed. Desorption experiments under dynamic conditions showed the vapor pressure of cuprous iodide to be about 2×10^{-9} mm of mercury at 20°C. When the loading was less than about one monolayer, the vapor pressure exerted was less than the normal value. The vapor pressure of silver iodide was below the limit of detection, viz. below about 10^{-11} mm of mercury at 20°C. Copper which had not been specially cleaned was not normally very reactive toward iodine vapor, the solid-phase transfer coefficient k_s varying from 0.1 to 0.5 cm/sec in dynamic experiments. However, a treatment with 2N nitric acid was sufficient to transfer rate control to the gas phase, when k_s must have been at least 20 cm/sec. The static experiments, carried out at an iodine concentration of 2.8 g/m^3, indicated a fall in k_s when more than about 10^4 monolayers had accumulated. An increase in the amount of surface oxide also reduced k_s. Copper which had been exposed to weather for 16 months possessed an appreciable reactivity, a 6 ft column exerting an average efficiency of 98% over 6 hours use. (auth)

14198 (AERE-R-4123) CHLORO COMPLEXES OF RUTHENIUM. PART I. GROUPS FORMED BY THE REDUCTION OF RUTHENIUM TETROXIDE WITH HYDROCHLORIC ACID. J. L. Woodhead and J. M. Fletcher (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Dec. 1962. 50p.

Five groups of chloro complexes are formed in solution under appropriate conditions by the reduction of RuO_4 with aqueous HCl. In each group there can be various ratios of aquo to chloro complexing. In addition to the mononuclear complexes of RuO_2(II), Ru^{4+} and Ru^{3+}, there are two polynuclear groups with Ru in the +4 oxidation state; one group, complexes of Ru_2O(VI), is already known in the diamagnetic anion $[Ru_2OCl_{10}]^{4-}$; in the other group, Ru is weakly paramagnetic and the complexes are postulated to be ones of Ru_2O_2(IV). The latter group is the primary condensation product and is formed by a fast reaction between Ru^{3+} and RuO_2(II) complexes. Information concerning the absorption spectra of these five groups was extended to cover a wide range of HCl concentrations and to include dioxochlororuthenate(VI) complexes. The rate of chloro complexing is slow for all the groups except RuO_2(II) and the strength of chloro complexing is placed in the order $Ru^{4+} > Ru^{3+} > RuO_2$(II) and Ru_2O(VI) > Ru_2O_2(IV). Conditions for preparing cesium dioxotetrachlororuthenate(VI), $Cs_2[RuO_2Cl_4]$, free from other chloro complexes were determined and its properties examined. It is an important intermediate in the reduction of RuO_4 by HCl, and the various chloro complexes with Ru in the +4 and +3 oxidation states are formed from it by alternative reactions which depend on the concentrations of HCl and of Cl_2 in the system. Potentials and rates were measured for the reactions $RuO_4 \rightleftharpoons RuO_2$(II) and RuO_2(II) $\rightarrow Ru_2O_2$(IV) in HCl media, and various infrared spectra and magnetic susceptibilities have been determined. (auth)

14199 (AERE-R-4149) THE CONVERSION OF BERYLLIA TO ANHYDROUS BERYLLIUM CHLORIDE. B. F. Greenfield, K. R. Hyde, and M. J. Waterman (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Sept. 1962. 25p.

A study was made of the conversion of BeO to $BeCl_2$ by means of C and Cl_2, and by such materials as CCl_4, C_2Cl_4, and $COCl_2$. Carbon tetrachloride and $COCl_2$ were successfully used as reagents in a fluidized bed. Some results are presented on the composition of the gaseous products of the reaction. (auth)

14200 (AGN-TM-401) COMPATIBILITY TESTS WITH HASTELLOY X IN OIL-CONTAMINATED GASES. J. S. Brunhouse and G. W. Titus (Aerojet-General Nucleonics, San Ramon, Calif.). Jan. 1963. Contract AT(10-1)-880. 68p.

Hastelloy X sheet and tubing materials were exposed at 1750°F to gases contaminated with lubricating oil in order to determine the compatibility of the Hastelloy X cladding on ML-1 fuel elements with coolant gases contaminated by possible leakage of oil from the turbine or compressor. The gases used were nitrogen, the ML-1 reference gas (99.5 vol% N_2 + 0.5 vol% O_2), and argon. Samples were evaluated by metallographic examination, chemical analysis, x-ray diffraction analysis, weight change measurements, and tensile testing. During exposure to oil-contaminated nitrogen at 1750°F, a second phase quickly forms in the Hastelloy X, resulting in embrittlement of the material. Nitrogen appears to be responsible for the formation of the embrittling phase, but the presence of hydrocarbons ac-

celerates its formation. Oxygen inhibits the formation of the second phase, which does not occur in Hastelloy X exposed to oil-contaminated reference gas at 1750°F, and the ductility of samples exposed under such conditions is acceptable. Argon was bubbled through the lubricating oil in the third series of tests to determine if the embrittling phase found in the samples from the first series was due to the presence of hydrocarbons or to nitrogen. That is, a similar formation would occur with the argon atmosphere if the embrittling phase were due to hydrocarbons; but if nitrogen were the cause, exposure of Hastelloy X to oil-contaminated argon would result in a microstructure closely resembling that produced by exposure to high-purity argon. The tests showed that a surface carbide (the embrittling phase) was formed by exposure to oil-contaminated argon. It was concluded that Hastelloy X appears to have good compatibility with a coolant contaminated with minor quantities of oil vapor if oxygen is present in the coolant gas. (auth)

14201 (ANL-6663) SOME FUNDAMENTAL ASPECTS OF VAPORIZATION. R. J. Ackermann, R. J. Thorn, and G. H. Winslow (Argonne National Lab., Ill.). Dec. 1962. Contract W-31-109-eng-38. 28p.

A discussion of the fundamental aspects of vaporization is presented along with a discussion of evaporation within the theories of solids and gases. Suggestions are offered as to where assumptions might be introduced to describe the phenomenon more completely, and tenative definitions concerning factors which can give rise to vaporization coefficients are given. An effort is made to unify these concepts within the phenomenological framework of irreversible thermodynamics. (J.R.D.)

14202 (BM-IC-8147) LIST OF REFERENCES TO METAL-HALIDE VAPOR PRESSURES WITH BIBLIOGRAPHY. F. D. Stevenson and S. D. Hill (Bureau of Mines. Albany Metallurgy Research Center, Ore.). Aug. 1962. 37p.

The references were obtained from a search of Chemical Abstracts 1907 to 1961, Nuclear Science Abstracts 1951 to 1960, and Engineering Index for more current work. 302 entries are included. (J.R.D.)

14203 (BM-RI-6198) THERMODYNAMIC DATA FOR GALLIUM AND SCANDIUM SESQUIOXIDES. L. B. Pankratz and K. K. Kelley (Bureau of Mines. Berkeley Thermodynamics Lab., Berkeley, Calif.). May 1962. 9p.

High-temperature heat-content values of gallium and scandium sesquioxides were measured from 298 to 1,800°K. The heat-content values were combined with heats and entropies of formation to obtain free energies of formation of gallium and scandium sesquioxides to 2,000°K. The thermodynamic stabilities of the sesquioxides of aluminum, gallium, scandium, and yttrium were compared. (auth)

14204 (CRL-76) SOME PROPERTIES OF HYDROGEN-BASED CLINOPTILOLITE. W. G. Mathers (Atomic Energy of Canada Ltd., Chalk River, Ont.). Jan. 1963. 22p. (AECL-1670)

Some properties of the inorganic cation-exchanger, clinoptilolite, were studied. These studies were directed towards gathering the data necessary to predict the useful lifetime of a column of clinoptilolite when used to remove Cs and Sr from the combined Chalk River low-level waste streams. Column loadings were done with synthetic Cs and Sr solutions containing various amounts of Ca and sodium hexametaphosphate. These potential interferences are expected in the actual waste stream. In these experiments, the mineral was converted to the hydrogen form before use by contacting it with dilute nitric acid. Contacting the mineral with nitric acids was found to destroy some of its exchange capacity. The extent of destruction depended on acid strength and time of contact. Ca at the level expected in the actual stream (5×10^{-4} N) reduced the mineral capacity for Sr by a factor of 3.5. This same level had no effect on Cs capacity. Sodium hexametaphosphate caused a severe reduction in the capacity of the mineral for Sr with a feed adjusted to pH 3.0. The average concentration of this agent in the actual waste was below the troublesome level, however. It is to be expected that even if the above conditions are encountered column lifetimes will still be great enough to be useful in practice. (auth)

14205 (HW-76389) ADVANCEMENTS IN WATER TREATMENT AT HANFORD. R. W. Pitman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 30, 1963. Contract AT(45-1)-1350. 13p.

The water treatment plants of the Hanford Atomic Facility are schematically diagrammed. The premise used at Hanford is that if the particles of the raw water can be made to collide with each other, they can be tacked together sufficiently not to pass through a filter. Methods used to implement this premise are described. (M.C.G.)

14206 (IA-781) THE CHEMISTRY OF TRIVALENT URANIUM IN AQUEOUS SOLUTIONS. Progress Report. M. Shiloh and Y. Marcus (Israel. Atomic Energy Establishment, Rehovoth). Dec. 1962. 19p.

Spectrophotometric studies of U(III) in concentrated LiCl and LiBr solutions revealed spectral changes (an intense band with peaks at 5440 and 5470 Å respectively), which are interpreted as representing the formation of UCl^{2+} and $LiBr^{2+}$, with formation constants log $K = -2.85 \pm 0.10$ and -3.95 ± 0.10, respectively. Considerably stronger spectral changes were observed in sulfuric acid solutions, while qualitative indication of complex formation was obtained also for thiocyanate and sulfite solutions, but none were found for perchlorate solutions. Nitrate solution could not be prepared. No absorption of U(III) on an anion exchanger and no extraction by triisooctylammonium chloride in xylene were found with concentrated LiCl solutions. Cation exchange experiments with the same solutions showed behavior intermediate between those of the lanthanides and the actinides. (auth)

14207 (IA-782) THE ANION EXCHANGE OF METAL COMPLEXES. XI. APPLICATION OF THE CONSTANT IONIC MEDIUM METHOD TO THE MERCURY HALIDE SYSTEM. I. Eliezer and Y. Marcus (Israel. Atomic Energy Commission, Rehovoth). Nov. 1962. 13p.

The possibilities of the application of the constant ionic medium method to investigations of metal complex formation by anion exchange were studied. In the case of the mercury–halide systems, it was necessary to use constants determined by another method, in order to determine stability constants for the resin phase, and using these, the constants for several ionic strengths. In principle, however, knowing the selectivity of the resin with respect to ligand and medium anions, the equations derived should allow the constants to be calculated independently. For this calculation it is necessary to know the variation of the distribution coefficients of tracer metal with ligand concentration under conditions of constant ionic strength of the ouside solution and limited substitution of medium anions by ligand anions. (auth)

14208 (IS-622) MAGNETOSTRICTION IN Dy AND Ho. S. Legvold, J. Alstad, and J. Rhyne (Ames Lab., Ames, Iowa). [Feb. 15, 1963]. Contract [W-7405-eng-82]. 7p.

Phenomenal magnetostriction was observed in Dy and Ho single crystals. For a circular basal plane Dy crystal preliminary measurements at 100°K show that a strain of -5800×10^{-6} develops along the a-axis when a 26 kOe applied field is rotated from parallel to an a-axis to parallel to a b-axis. This is sixty times as large as the magnetostriction in Co. The maximum strain along the a-axis shows a nearly linear decrease with increasing temperature above 100°K. In the case of a basal plane Ho crystal at 45°K it was found that when the 26 kOe applied field was rotated from parallel to an a-axis to parallel to a b-axis there was a maximum contraction along the a-axis of 2300×10^{-6} whereas there was a maximum expansion of 1600×10^{-6} along the b-axis. When a circular crystal containing the b and c axes was magnetized from 0 to 26 kOe at 45°K, a strain of $+3500 \times 10^{-6}$ was observed along the c-axis. This magnetostriction curve showed three slightly developed knees which agree well with the knees observed in the magnetization data for Ho previously reported. (auth)

14209 (LA-2828) COMPATIBILITY OF THE MAJOR ELEMENTAL COMPONENTS OF TYPE 302-B STAINLESS STEEL WITH PuO_2 AND UO_2. W. C. Pritchard, K. A. Johnson, and J. A. Leary (Los Alamos Scientific Lab., N. Mex.). Oct. 25, 1962. Contract W-7405-eng-36. 32p.

The compatibility of Fe, Cr, Ni, Si, and types 302 and 302-B stainless steel powders with PuO_2 powder in sintered compacts was studied. The composition of the compacts was 50 vol% PuO_2. The powders were mixed and cold compressed at 50 tsi and the resulting pellets were sintered in argon at 1325 or 1425°C for times between 2 and 28 hr. The pellets were examined metallographically and their densities were determined. It was found that under the test conditions, Si and type 302-B stainless steel, but not Ni and type 302 stainless steel, reacted with PuO_2. The results for Cr and Fe were less conclusive. The compatibility of 302-B stainless steel and Si powders with UO_2 powder was also studied. It was found that UO_2 reacted with Si but not with the stainless steel. (auth)

14210 (NBS-MON-25(Sect. 1)) STANDARD X-RAY DIFFRACTION POWDER PATTERNS. Howard E. Swanson, M. C. Morris, Roger P. Stinchfield, and Eloise H. Evans (National Bureau of Standards, Washington, D. C.). Mar. 9, 1962. 58p.

Forty-six standard x ray diffraction powder patterns are presented. Fourteen are to replace twelve patterns already given in the x ray Powder Data File, and thirty-four are for substances not previously included. The patterns were made with a Geiger counter x ray diffractometer, using samples of high purity. The d-values were assigned Miller indices determined by comparison with calculated interplanar spacings and from space group considerations. The densities and lattice constants were calculated, and the refractive indices were measured whenever possible. (auth)

14211 (NSEC(T)-18) VOLATILE IODINE TRANSPORT THROUGH PIPES. R. C. Koch, R. H. Marsh, and I. J. Gruverman (Nuclear Science and Engineering Corp., Pittsburgh). Apr. 25, 1960. Contract [AT(30-1)-2588]. 15p.

A method and apparatus were developed for measuring the transport of carrier-free iodine by gas streams through small pipes or tubes. I^{131} was used as a tracer. Two experimental examples are described. (M.C.G.)

14212 (NYO-10535) KINETICS OF REACTIONS BETWEEN LIQUID METALS AND LIQUID SALTS. Progress Report, March 1, 1962 to December 30, 1962. Thomas B. King (Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy). Contract AT(30-1)-1985. 43p.

The general filatures of reactions in salt-metal systems were elucidated. Research on reactions at metallic electrodes in oxide melts is reported in which lithium silicates were chosen as electrolytes because they are representative of oxide melts in which the anions are complexed and which may involve slow electrode processes. Results of these experiments are discussed, and it is noted that establishment of detailed mechanisms for these reactions requires further work. A detailed discussion is included concerning studies with carbon electrodes. Other work is noted, and report number references are given. (J.R.D.)

14213 (ORNL-3278) HYDROLYSIS OF U(VI): ACIDITY MEASUREMENTS IN CHLORIDE SOLUTIONS AND ABSORPTION SPECTRA IN CHLORIDE AND PERCHLORATE SOLUTIONS. R. M. Rush, J. S. Johnson, and K. A. Kraus (Oak Ridge National Lab., Tenn.). Mar. 1, 1963. Contract W-7405-eng-26. 16p.

Interpretations of acidity data (based on emf measurements) and optical absorption measurements of hydrolyzed U(VI) solutions in chloride and perchlorate media are presented. Tables of results of the acidity data obtained with cells having a liquid junction and without liquid junction, and details of the least squares computational program by which acidity measurements were analyzed are shown. Optical absorption curves of hydrolyzed U(VI) chloride and perchlorate solutions in the region 3650 to 5000 Å are presented. (H.G.G.)

14214 (ORNL-3304) PHASE EQUILIBRIA IN THE SYSTEM $NaF-UF_4$. R. E. Thoma, Herbert Insley, G. M. Hebert, H. A. Friedman, and C. F. Weaver (Oak Ridge National Lab., Tenn.). Feb. 21, 1963. Contract W-7405-eng-26. 55p.

Condensed version published in J. Am. Ceram. Soc., 46: 37-42(Jan. 21, 1963).

Phase equilibria in the condensed system $NaF-ThF_4-UF_4$ were determined by cooling curve and thermal gradient quenching experiments from the liquidus to ~450°C. A phase diagram of the ternary system was constructed, showing three singular points and eleven invariant points, including two eutectics, occurring in association with the primary phases of ten solid solutions and two pure solids. The eutectic mixture having the composition 75.5NaF–10.5ThF_4–14UF_4 (mole %), melts at 575°C, the lowest liquidus temperature in the system. Except for NaF, $NaF \cdot ThF_4$, and ThF_4-UF_4 solid solutions, phases crystallizing from molten $NaF-ThF_4-UF_4$ mixtures are solid solutions formed by exchange of U^{4+} and Th^{4+} ions in $NaF-ThF_4$ and $NaF-UF_4$ compounds. No ternary compounds were found. Phase diagrams of the systems $NaF-ThF_4$ and $NaF-UF_4$, revised in the course of this study to include the newly identified phases, $7NaF \cdot 2ThF_4$ and $7NaF \cdot 2UF_4$, are presented. X-ray-diffraction and optical data are given for the pure crystal phases, $4NaF \cdot ThF_4$, $7NaF \cdot 2ThF_4$, $7NaF \cdot 2UF_4$, $3NaF \cdot UF_4$, and for $3NaF \cdot 2ThF_4-5NaF \cdot 3UF_4$ solid solutions. The system is unique among fluoride systems reported in that it contains a wide variety of substitutional solid solutions and a continuous solid solution formed of binary compound pairs, $3NaF \cdot 2ThF_4$ and $5NaF \cdot 3UF_4$, which are isomorphous but of different stoichiometry. (auth)

14215 (PAN-362/IV) PROPERTIES OF SEDIMENTS OF SPARINGLY SOLUBLE COMPOUNDS OBTAINED BY A VERY SLOW PRECIPITATION TECHNIQUE. Tadeusz Adamski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Oct. 1962. 26p.

A new technique of very slow precipitation of sparingly soluble salts is described. With the aid of this method, sediments of crystallites of barium chromate can be obtained. The different shapes of the crystallites are supposed to be formed due to the presence of impurities of reagents, acting as specific crystallization centers. A number of characteristic features are observed and described, e.g., effects which are supposed to be radiation effects provided by traces of radium in chromates. (auth)

14216 (TID-17968) SOME ASPECTS OF THE STRUCTURE AND STABILITY OF THE CUBIC HEXABORIDES OF THE LANTHANONS. George D. Sturgeon and Harry A. Eick (Michigan State Univ., East Lansing). [1961]. Contract [AT(11-1)-716]. 10p.

Investigations concerning preparation and structure of the hexaborides of Er, Tm, and Lu are described. (J.R.D.)

14217 (TID-18033) ELECTRIC RESONANCE MICROWAVE SPECTRUM, SPECTROSCOPIC CONSTANTS, AND ELECTRIC DIPOLE MOMENT OF Li^6F^{19}. L. Wharton, W. Klemperer (Harvard Univ., Cambridge, Mass.); L. P. Gold (Columbia Univ., New York. Columbia Radiation Lab.); R. Strauch, J. J. Gallagher, and V. E. Derr (Martin Co., Orlando, Fla.). [1962]. Contract AT(30-1)-2382. 25p.

Transitions between the J = 1 and J = 0 rotational states of Li^6F^{19} were measured by means of the molecular beam electric resonance method in the four lowest vibrational states. By this means the rotational constants of Li^6F^{19} were determined. These enabled the rotationally resolved infrared vibration-rotation spectrum of Li^7F^{19} observed by Vidale to be properly assigned and the correct vibrational constants to be determined. Transitions between the M = 0 and |M| = 1 orientations of the J = 1 rotational state of Li^6F^{19} in the four lowest vibrational states in a strong electric field were measured to high precision, which enabled the dipole moments to be determined accurately and a nonlinear variation of dipole moment with vibrational state to be observed. The molecular constants obtained for Li^6F^{19} were $B_v = 45.2308111 - 0.7223089\ (v + \frac{1}{2}) + 0.0058270\ (v + \frac{1}{2})^2 \pm 0.0000050$ gc, $\omega_v = 964.07 - 8.895\ (v + \frac{1}{2})$ cm^{-1}, $r_e = 1.563892 \pm 0.000050$ Å, and $\mu_v = \{6.28446 + 0.08612\ (v + \frac{1}{2}) + 0.00060\ (v + \frac{1}{2})^2\} \pm 0.00100$ D. (auth)

14218 (TID-18034) MICROWAVE SPECTRUM OF BaO. L. Wharton and W. Klemperer (Harvard Univ., Cambridge, Mass.). [1963]. Contract [AT(30-1)-2382]. 14p.

Transitions between the J = 1 and J = 0 rotational states of $Ba^{138}O^{16}$ have been measured by means of the molecular beam electric resonance technique in the four lowest vibrational states. By this means the rotational constants of BaO were determined to a high degree of accuracy. The previous excellent determination of the rotational constants of BaO by the analysis of optical spectra by Lagerqvist, Lind, and Barrow was confirmed. Additional evidence is found to support the claim that the lower state observed in the optical spectra is the ground state, and this state has no net electronic angular momentum. (auth)

14219 (UCRL-7168) THE THERMODYNAMIC FUNCTIONS FOR CARBON DIOXIDE IN THE RANGE 40 TO 1000°C AND 1 TO 1400 BARS. W. E. Sharp (California. Univ., Los Angeles. Inst. of Geophysics). Dec. 19, 1962. For Univ. of California, Lawrence Radiation Lab., Livermore. Contract W-7405-eng-48. 53p.

Extensive measurements on the pressure-volume-temperature relations of CO_2 were made. Tables of the thermodynamic functions in the temperature range 40–1000°C and pressure range 1–1400 bars are presented. (H.G.G.)

14220 (UCRL-10403) ISOTROPIC HYPERFINE ENERGY OF INTERACTION OF FREE RADICALS IN SOLUTION. J. V. Acrivos (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 1962. Contract W-7405-eng-48. 5p.

For a system undergoing rapid Brownian motions, the isotrophic hyperfine energy of interaction with a nucleus of spin I_n is modulated by the time dependence of the electron density distribution, as follows: $I_{hfs} = [A_0 + A(t)]\,\vec{I}\cdot\vec{S}$. Two major conclusions can be drawn from this equation; (1) the functional dependence of the observed hyperfine splitting constant on the electron density in the vicinity of the free radical and (2) the effect of the secular, time-dependent perturbation on the lifetime of the Zeeman hyperfine levels of equal symmetry and total component of angular momentum. (H.G.G.)

14221 (AEC-tr-5668) ROLE OF SURFACE NONUNIFORMITY IN THE ADSORPTION AND IONIZATION OF SODIUM AND LITHIUM ON TUNGSTEN. A. M. Romanov and S. V. Starodubtsev. Translated by Lydia Venters (Argonne National Lab., Ill.) from Izv. Akad. Nauk Uz. SSR, Ser. Fiz.-Mat. Nauk, No. 3, 11-26(1957). 18p.

The adsorption and ionization phenomena of Na and Li atoms on W were studied. Problems associated with the structure and emission properties of W surfaces following thermal treatment were investigated. (M.C.G.)

14222 (AEC-tr-5676) ELECTRICAL CONDUCTIVITY OF MIXTURES OF FUSED SALTS. Y. Doucet and M. Bizouard. Translated from Bull. Soc. Chim. France, 1570-7 (1959). 20p.

A method for the measurement of the specific conductivity of fused salts, by elimination of polarization resistance, is described. The potential difference at the terminals of a reference resistance is compared to that existing between two probes immersed in the fused salt. The accuracy of the method and the causes of error are discussed. The results are compared to those obtained by other authors; the conductivity isotherms of the system $LiNO_3$-$NaNO_3$ are given. (auth)

14223 (AEC-tr-5679) CRITICAL STUDY OF THE METHODS USED FOR MEASURING THE ELECTRICAL CONDUCTIVITY OF MOLTEN SALT BATHS. R. Winand. Translated from Electrochim. Acta, 3: 106-14(1960). 14p.

Results of measurements of electrical conductivity in molten salts show a wide scatter. It is interesting to compare the methods used by different workers with theory and to draw practical conclusions. The basic principles of the methods employed in aqueous solution, particularly the equivalent electrical circuit for an a-c conductivity cell, are considered. Having shown that according to recent studies, a similar scheme is valid for molten salts, we review the experimental work, taking into account materials employed, the conditions of control of the atmosphere, the elimination of impurities in the molten bath, the form and calibration of measuring cell, and the elimination of polarization. Finally, the most important precautions that must be observed in order to obtain valid measurements of electrical conductivity of molten salts are shown. (auth)

14224 (AEC-tr-5683) KINETIC ANALYSIS OF THE NUCLEUS FORMATION IN SUPERSATURATED VAPOR. R. Becker and W. Doering. Translated by Lydia Venters (Argonne National Lab. Ill.) from Ann. Physik, 24: No. 5, 719(1935). 31p.

Any supersaturation is associated with a definite critical drop size of the new phase of a kind such that the vapor is supersaturated only in comparison with such drops that are larger than the critical drop. In comparison with smaller drops, the vapor is undersaturated. For example, for the formation of fog, it is necessary that as a result of a typical oscillation phenomenon, nuclei, which are small drops of any critical size, must originate. The nucleus formation can be investigated on the transmission of the electric current through a wire net provided the electric potential difference at the ends of the net and the ohmic resistances of the individual wire parts that form the net are given. Using this method, a relatively simple and clear calculation of nucleus formation frequency for surface or spatial nuclei is presented. (H.G.G.)

14225 (AERE-Trans-923) OPTICAL PROPERTIES OF URANIUM HEXAFLUORIDE. II. PHOTOLUMINESCENCE OF ITS TEMPERATURE DEPENDENCE. G. D. Sheremet'ev. Translated by J. M. Crabtree (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Opt. i Spektroskopiy., 2: No. 1, 99-106(1957). 9p.

The luminescence spectrum of solid UF_6 at 88°K has been studied. The spectrum consists of 20 overlapping bands in the 4040–4870 Å region. The frequency of the purely electronic transition is 24,540 cm^{-1}. The difference in frequency of 200 cm^{-1} between adjacent bands in the luminescence spectra agrees with a fundamental frequency of the Raman spectrum of UF_6. The luminescence spectrum is independent of the wavelength of the exciting light. Temperature quenching of luminescence in the 97–120°K range is accompanied by a parallel reduction in the duration of the excited state. (auth)

14226 (CEA-tr-A-1227) PROCÉDÉ D'ENRICHISSEMENT D'EAU OU D'HYDROGÈNE EN DEUTÉRIUM. (Process for the Enrichment of Water or Hydrogen in Deuterium). Rolf Manteufel. Translated into French from German Patent 1076093. Oct. 11, 1958. 9p.

A procedure for the deuterium enrichment of water or hydrogen in exchange columns connected in series and maintained at different temperatures is described. A pressure difference of at least 50 effective atmospheres is maintained between the hot column and the cold column. The pressure in the hot column at a temperature of 150°C is kept between 50 and 300 atm, and that of the cold column between 1 and 30 atm. In coupling the series-connected hot and cold columns with the hydrogen generator, the isotope exchange column, installed before the generator, is kept at a pressure lower than that of the cold columns of the combined hot and cold column system. (J.S.R.)

14227 (DEG-Inf/Ser.-146) CHLORINE DIOXIDE. PART 2. STUDIES ON LABORATORY SCALE PREPARATION. J. Kepinski. Translated by L. H. Sinclair (U.K.A.E.A., Development and Engineering Group, Risley, Lancs, England) from Przemysl Chem., 34: 124-8(1955). 13p.

The course of reaction in which sodium chlorate is reduced using sulphur dioxide in a batch bubble reactor was studied. It was found that the composition of the evolved gases changes with time of the reaction. Specifically, the molar ratio of chlorine dioxide to chlorine increases since chlorine dioxide accumulates in solution, due to changes in the reaction mechanism, these changes being related to the reduction in the chlorate concentration of the solution. When the experiments were carried out on a continuous basis, it was found that this ratio is the higher, the more dilute the solutions undergoing reduction. If the chlorate concentration is maintained within the limits 30 to 100 millimoles per liter, chlorine dioxide is obtained with very small admixtures of chlorine (molar ratio $ClO_2 : Cl_2 > 30$). (auth)

14228 TIME CHARACTERISTICS OF SEMI-CONDUCTOR DETECTORS. N. Vîlcov (Inst. of Atomic Physics, Bucharest). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 13: 715-21(1962). (In Rumanian)

By using the physical processes accompanying the passage of an ionizing particle crossing an n-p layer, the most important factors for the time resolution of semiconductor detectors were determined. The introduction of the notion of the "time quality factor" of a semi-conductor detector permits a unitary appreciation of the time characteristics of this type of detector. The effect of associated electronics on the time resolution in connection with the utilization of semi-conductor detectors in slow-fast coincidence schemes is analyzed. (tr-auth)

14229 EQUILIBRIUM DIAGRAM AND MASSES OBTAINED FROM MELTS IN THE SILICON DIOXIDE–URANIUM DIOXIDE SYSTEM. S. N. Lungu (Inst. of Atomic Physics, Bucharest). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 13: 739-46(1962). (In Rumanian)

The phase diagram of the SiO_2–UO_2 system in a hydrogen atmosphere is established. This diagram is analyzed thermodynamically with the values of free and internal energies and the entropy with respect to the pure liquid phases of UO_2 and SiO_2. The structure of the melted products is described. The masses obtained from these melts by crystallization during cooling is given, with concentrations up to 7 g UO_2/cm^3. The mechanism of the crystallization is determined. Some properties of the masses, with respect to their utilization as fuels for nuclear reactors at high temperatures, offer the advantage of retaining the fission gas. (tr-auth)

14230 DETERMINATION OF THE H–D ISOTOPE EFFECTS BY THE MEASUREMENT OF THE ELECTRODE POTENTIAL OF TANTALUM. V. Znamirovschi (Univ. of Babes-Bolyai, Cluj, Rumania). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 13: 765-73(1962). (In Rumanian)

The isotopic effect of deuterium on the electrode potential of metallic tantalum, used as a normal hydrogen electrode, is shown. (tr-auth)

14231 STUDIES ON THE HYDROLYSIS OF METAL IONS. 43. A THERMOCHEMICAL STUDY OF HYDROLYSED $Be(ClO_4)_2$ SOLUTIONS. Birgitta Carell and Ake Olin (Royal Inst. of Tech., Stockholm). Acta Chem. Scand., 16: 2357-62(1962). (In English)

Enthalpy titrations were performed with hydrolysed $Be(ClO_4)_2$ solutions (25°C, 3M $NaClO_4$). The hydrolysis mechanism proposed by Kakihana and Sillén, viz. 2 Be^{2+} + $H_2O \rightleftharpoons Be_2OH^{3+} + H^+$ and 3 Be^{2+} + 3 $H_2O \rightleftharpoons Be_3(OH)_3^{3+}$ + 3 H^+ was used as the basis for the interpretation of the heat data. These gave for reaction (1) $\Delta H = 4.43 \pm 0.10$ kcal/mole; $\Delta S = 0.2 \pm 0.6$ eu and for reaction (2) $\Delta H = 15.18 \pm 0.05$ kcal/mole; $\Delta S = 11.3 \pm 0.3$ eu. (auth)

14232 INVESTIGATION OF SOME ELECTRODE PROCESSES IN IRRADIATED AQUEOUS SOLUTIONS. I. Kósa-Somogyi (Central Inst. of Physical Research, Hungarian Academy of Sciences, Budapest). Acta Chim. Acad. Sci. Hung., 35: 85-93(1963). (In German)

The variation in the potentials of electrodes of plain platinum, gold, platinized platinum, and stainless steel was measured in irradiated aqueous solutions as a function of absorbed dose and of solution acidity. For 10^{-4} M/l solu-

tions of potassium dichromate in the pH range from 0.5 to 2, until $Cr_2O_7^{-2}$ becomes completely reduced, the electrode potential of plain platinum proved to be determined by the ratio of activity of the oxidized form to that of the reduced form of this element; thus the reduction process can be followed by measuring the variation in electrode potentials. Up to the pH value 2, the potential varies with the ratio $2\ H^+/H_2$, that is the stable potential is a linear function of the pH value of the solution. A deviation from this linear dependence, assumed to be due to the catalytical decomposition of H_2O_2, was observed in the pH = 2 to 3 range. The electrode potentials of plain platinum and gold proved to be determined in irradiated sulfuric acid solutions by the ratio $2\ H^+/H_2$ unaffected by radiation. Since in these solutions ranging from pH 0.5 to 7, the electrode potential of stainless steel remains in the domain of passivity that is in the range of +200 to +300 mv (n.h.e.), the corrosion rate does not increase under the action of γ radiation. (auth)

14233 HOW GOOD ARE THE NEW ATOMIC WEIGHTS? Edward Wichers (National Academy of Sciences-National Research Council, Washington, D. C.). Anal. Chem., 35: 23A-32A(Mar. 1963).

Aspects of the newly adopted 1961 International Table of Relative Atomic Weights, based on 12 as the assigned atomic mass of C^{12}, that should make it more useful to chemists are presented. Discussion is also given on its limitations and possible means of further improvement. It is stressed that chemical methods and mass spectrometric procedures can often complement each other. (P.C.H.)

14234 LIMITED AREA FLAME SPECTROMETRY. CHEMILUMINESCENCE. Bruce E. Buell (Union Oil Co. of California, Brea). Anal. Chem., 35: 372-82(Mar. 1963).

Limited area techniques were utilized to investigate the excitation possibilities of the oxyhydrogen flame atomizing organic solvents. Chemiluminescence, or inner cone excitation greater than expected from thermal excitation, was studied by correlating excitation potentials and dissociation energies with height of maximum emission above the burner tip and solvent-enhancing factors. Over 600 atomic lines, with excitation potentials varying from 2.1 to 9.0 ev, were recorded, many for the first time in flames. Only selected lines are presented in tables and representative spectra. The tables establish conclusively that as excitation potentials increase, solvent-enhancing factors increase and height of maximum emission in the flame decreases until that for CO and CH emission is reached. Chemiluminescence and chemical reduction in the flame are offered as possible explanations for this and as a major contributor for large solvent-enhancing factors (established as exceeding 40000-fold). (auth)

14235 PURIFICATION OF REACTOR MODERATOR-COOLANTS. E. Proksch. At. Energy Rev., 1: No. 1, 5-42 (1963). (In English)

Problems related to the purification of light and heavy water and the organic liquids used as moderator-coolants for nuclear reactors are reviewed. The sources of impurities are described. Corrosion is the main source in water systems, radiolytic tar formation in organic systems. Specified and actually observed values for the concentration of different impurities are discussed. The methods and the equipment used in purification are described. The main units considered are ion exchangers, filters, degasifiers, and distillation columns. Design, construction, operation, and trends of development are discussed. The problem of purification can be solved by well-developed methods, with considerable success. However, most of the methods are capable of further improvement. (auth)

14236 CONCENTRATION OF ^{32}P FROM IRRADIATED $MgSO_4$ BY ADSORPTION ON METAL MAGNESIUM. O. Ž. Jovanović-Kovačević, S. M. Milenković, and Č. M. Teofilovski. Bull. Inst. Nucl. Sci. "Boris Kidrich" (Belgrade), 13: No. 4, 1-8(Dec. 1962).

The conditions of the adsorption of P^{32} on metal magnesium from aqueous solutions and solutions of magnesium sulfate of various concentrations, depending on the quantity of the adsorbent, the temperature and the time of contact, were investigated. The results obtained indicate that metal magnesium may be used as a selective adsorbent for P^{32} for separating carrier-free P^{32} from irradiated $MgSO_4$. (auth)

14237 POTENTIOMETRIC STUDY OF CARBONATO-THORIUM COMPLEXES. Jacques Faucherre and Jacqueline Dervin (Faculté des Sciences, Reims). Compt. Rend., 255: 2769-71(Nov. 19, 1962). (In French)

It was shown previously that Th^{4+} and the tetracondensed basic ions $Th_4(OH)_8^{8+}$ gives rise in the presence of an excess of CO_3^{2-} to a carbonatothorium complex. In the present study, the structure of this complex ion is verified using the neutralization curves. It was shown that the complex has the formula $Th(CO_3)_5^{6-}$. (J.S.R.)

14238 PRODUCTION OF METALLIC ZIRCONIUM BY IGNEOUS ELECTROLYSIS BEGINNING WITH ZIRCONIUM OXIDE. Claude Decroly, André Fontana, and René Winand (Université Libre, Brussels). Compt. Rend., 255: 2953-4(Nov. 26, 1962). (In French)

The possibility of producing metallic Zr by electrolysis of fused salt mixtures under conditions such that the metal is produced directly from ZrO_2 was studied. The use of sodium chloride and of sodium fluoride as melts produced no positive results. Electrolysis of fused mixtures of ZrF_4 and NaF to which ZrO_2 is added was investigated. The conditions of the electrolysis giving the best yield were determined. The metallic powder obtained was charged with oxygen. (J.S.R.)

14239 CALCULATIONS OF THE ION EXCHANGE EQUILIBRIA. WEAK BASE RESIN IN BUFFERED MEDIUM. Éric Selegny and Yves Merle (Faculté des Sciences de Nantes, Paris). Compt. Rend., 256: 674-6(Jan. 14, 1963). (In French)

The distribution constant at equilibrium of an anion between a weak base resin and a weak base solution is calculated from the equations of their curves of neutralization by this anion. The experimental pH are in good agreement with those calculated. (tr-auth)

14240 HYDROLYSIS OF MIXTURES OF URANIUM MONOCARBIDE AND DICARBIDE. Jean Besson, Pierre Blum, and Jean Spitz (Centre d'Etudes Nucléaires, Grenoble, France). Compt. Rend., 256: 681-3(Jan. 14, 1963). (In French)

Hydrolysis in neutral or acid media of mixtures of UC and UC_2 leads to the formation of a complex mixture of gaseous hydrocarbides and saturated and ethylene condensates. The hydrocarbide-pair percentage of the aggregate of the hydrocarbides released increases with the concentration in dicarbide and tends toward 100% for pure dicarbide. The reaction mechanism proposed takes these data into consideration. (tr-auth)

14241 ON THE SYNTHESIS OF AND MAGNETIC MEASUREMENTS ON XENON TETRAFLUORIDE. J. Sliv-

nik (Nuclear Research Inst. "Jožef Stefan," Ljubljana, Yugoslavia), B. Brčič, B. Volavšek, A. Šmalc, B. Frlec, R. Zemljič, A. Anžur, and Z. Veksli. Croat. Chem. Acta, 34: 187-8(1962). (In English)

The synthesis of XeF_4 was verified and more details of the preparation are given. Xenon (1 atm) and fluorine (3 atm) were introduced into a 850 ccm monel metal reaction vessel. A special construction of a vacuum tight valve withstanding 150 atm. was used. The reaction was completed after 3 hours heating at 400°C. Magnetic susceptibility measurements indicate a temperature dependent diamagnetism becoming less negative below 240°K. (auth)

14242 FLUORINE MAGNETIC RESONANCE IN XENON TETRAFLUORIDE. S. Marič̆ić and Z. Veksli (Inst. of Ruder Boškovic, Zagreb). Croat. Chem. Acta, 34: 189-90 (1962). (In English)

Below 237°K the spectra became asymmetric with a shape characteristic of substances with paramagnetic properties. Above this temperature the line shapes were symmetric with a second moment between 3.5 gauss (at 237°K) and 2.7 gauss (at 293°K). The latter values are discussed in relation to the molecular structure of xenon tetrafluoride. (auth)

14243 MASS SPECTROMETRIC MEASUREMENTS OF XENON FLUORIDES. J. Marsel and V. Vrščaj (Nuclear Research Inst. "Jožef Stefan", Ljubljana, Yugoslavia). Croat. Chem. Acta, 34: 191-3(1962). (In English)

The spectra were recorded with a modified Nier type spectrometer It was found necessary to introduce the sample vapors continuously for 48 hours in order to drop the Xe^+/XeF^+ ratio from 100:1 to 5:1. The masses in the spectral range above the position corresponding to XeF_4 are suggested to be due to $XeOF_4^+$, $XeOF_3^+$, $XeOF_6^+$ or higher xenon fluorides up to XeF_8. (auth)

14244 INTERACTION OF URANIUM OXIDES WITH THE OXIDES OF VANADIUM AND NIOBIUM. L. M. Kovba, Van Shi-Khua, and E. I. Sirotkina (Moscow State Univ.). Dokl. Akad. Nauk SSSR, 148: 113-5(Jan.-Feb. 1963). (In Russian)

Studies carried out by x-ray diffraction and thermal and chemical analysis revealed the existence of 2 phases resulting from the interaction of the oxides of U with those of V and Nb. The tests involved boiling aqueous suspensions of uranyl hydroxide, $UO_2(OH)_2$, with V_2O_5 for periods ranging from 85 to 100 hours. Keeping the U:V ratio within 1:2 to 1:3 only uranyl vanadate was obtained; changing this ratio to 3:2 resulted in the formation of a 2-phase system of U pyrovanadate and α-$UO_2(OH)_2$. The water-free orthovanadate was obtained by heating the pyrovanadate with uranyl hydroxide to 575°C. The $(UO_2)_3(VO_4)_2$ melted at 805 to 810°C under decomposition. Dehydration of the pyrovanadate, which melted at 790°C, was accompanied by the formation of α and β-$(UO_2)_2V_2O_7$. Dehydration of the hexavanadate at 260°C yielded β-$(UO_2)_2V_6O_{17}$, changing into its α-modification at 550°C. At 600 to 1000°C in vacuum V pentoxide reacts with UO_2 and U_3O_8 forming UV_3O_{10} and UVO_5. Nb pentoxide does not react with the aqueous uranyl hydroxide suspension; upon dehydration Nb_2O_5 and γ-UO_3 is obtained. The latter is decomposed at 675°C into lower oxides while the Nb_2O_5 is transformed into its high-temperature modification beyond 1000°C. Thus, in spite of the structural similarity, the α-Nb_2O_5 does not react with U_3O_8 and UO_3, although a reaction may take place at higher temperatures. (TTT)

14245 SOLUBILITY VALUE OF $RaSO_4$ IN WATER. Richard B. Holtzman (Argonne National Lab., Ill.). Health Phys., 9: 86(Jan. 1963).

A literature survey on the solubility of $RaSO_4$ in water is given, and the degree of acceptance of each value is discussed. It is concluded that the accepted value is Nikitin and Tolmatschoff's value, 2.1×10^{-4} g $RaSO_4$/100 ml H_2O at 25°C. (D.L.C.)

14246 ON THE REDUCED FROST-KALKWARF VAPOR PRESSURE EQUATION. Donald G. Miller (Univ. of California, Livermore). Ind. Eng. Chem. Fundamentals, 35: 78-9(Feb. 1963). (UCRL-7050-T)

The various forms of the reduced Frost-Kalkwarf vapor pressure equation and the equations relating the constants are given and discussed. A table of constants are given for a large number of inorganic and organic liquids. The following equations are derived: $\log P_r = 0.4343 [c - 2 - 0.57817(\alpha_c - 2)] \times (1/T_r - 1) + c \log T_r + 0.1832(P_r/T_r^2 - 1)$ and $\log P_r = 0.1832(\alpha_c - 2)^2(1 - 1/T_r) + [\alpha_c - 0.42183(\alpha_c - 2) \times (\alpha_c - 1)] \log T_r + 0.1832(P_r/T_r^2 - 1)$. The fit of the equations are discussed. (D.L.C.)

14247 AQUEOUS CHEMISTRY OF ZIRCONIUM: PART I. ZIRCONYL CHLORIDE AND WATER SYSTEM. V. V. Subbanna and A. K. Bhattacharya (Univ. of Saugar, India). Indian J. Chem., 1: 1-3(Jan. 1963).

The nature of zirconium species in aqueous zirconyl chloride solution was studied by dialysis, potentiometric, and conductometric methods. The amounts of zirconium, chlorine, and hydrogen determined during the course of dialysis lead to the conclusion that $[Zr_4(OH)_8(H_2O)_{16}]^{8+}$ ion present in solid $ZrOCl_2 \cdot 8H_2O$ loses 8 protons by oxolation and gives raise to colloidal $[XZrO_2 \cdot YH_2O]$ micelle when the salt is dissolved in water. Protons act as stabilizing ions imparting a positive charge to the colloidal particle. Addition of alkali removes the stabilizing protons and thus causes the coagulation of the colloidal species even before the addition of two equivalents of alkali. (auth)

14248 DEPOSITION OF RADIOACTIVE TRACERS ON PREFORMED IONIC PRECIPITATES. PART V. ADSORPTION OF ORTHOPHOSPHATE IONS ON IGNITED STRONTIUM SULPHATE. K. R. Kar and M. M. Bhutani (Delhi Univ.). Indian J. Chem., 1: 3-6(Jan. 1963).

The carrying of carrier-free radioactive orthophosphate ions, $(P^{32}O_4)^{3-}$, by ignited strontium sulfate was investigated. The deposition of the radionuclide was examined for effect of varying the pH of the suspension medium on the instantaneous deposition of the radionuclide in the absence and in the presence of added lattice and non-lattice ions; effect of varying the concentration of added lattice and non-lattice ions on the instantaneous adsorption of radionuclide at a constant pH of the suspension medium; and effect of varying the time of contact of the radionuclide with the carrier surface on the carrying process under varying experimental conditions. The fraction of P^{32} carried increased with increase in pH of the suspension medium, the concentration of lattice cations and the time of contact of radionuclide with the carrier surface; the carrying of P^{32} decreased with increase in the concentration of added lattice anions. On the basis of the results, it is postulated that the carrying of P^{32} is due to surface adsorption, in all probability, by the counter ion exchange mechanism. (auth)

14249 STUDIES ON THE PREPARATION AND PROPERTIES OF URANIUM(IV) NITRATE. T. R. Bhat and B. S. Mathur (Atomic Energy Establishment, Trombay, India). Indian J. Technol., 1: 14-19(Jan. 1963).

Uranium(IV) nitrate was prepared by photochemical reduction of uranyl nitrate in the presence of ethanol and by reacting uranium(IV) sulfate and barium nitrate or uranium(IV) chloride with silver nitrate. Hexavalent uranium was separated from the tetravalent uranium by solvent extraction with 5 to 10% tributyl phosphate (TBP) solution in kerosene and later uranium(IV) nitrate was separated from other impurities by 20% TBP extraction. The molar absorption spectrum of uranium(IV) nitrate agreed with that of uranium(IV) perchlorate. The kinetics of the decomposition (oxidation) of tetravalent uranium nitrate under different conditions was studied and the probable mechanisms are discussed. Uranium(IV) nitrate was found to form a complex of the type $U(NO_3)_4 \cdot 2TBP$ with TBP. (auth)

14250 PREPARATION OF PURE OXIDES OF ZIRCONIUM AND HAFNIUM FROM INDIAN ZIRCON. J. Gupta, V. Yatirajam, and S. R. Harisangam (National Chemical Lab., Poona, India). Indian J. Technol., 1: 20-4(Jan. 1963).

An integrated method was developed for the preparation of kilogram quantities of pure zirconia (Hf/Zr < 100 ppm) and gram quantities of hafnia from Indian zircon. Pure zirconia is obtained by frontal separation of the mixed oxychlorides in HCl–MeOH on an activated silica gel column. The hafnium concentrate retained by silica gel, further enriched by passage of the oxychloride through a secondary silica gel column was converted to potassium hexafluoro hafnate-zirconate. This was then loaded on the top of a column of strongly basic anion-exchanger (Amberlite IRA-400 or Dowex-2) and eluted with dilute sulfuric acid to give pure hafnia in the early eluate fractions. (auth)

14251 PRODUCTION OF CHLORINE-36 AND CARRIER-FREE SULPHUR-35 FROM PILE IRRADIATED POTASSIUM CHLORIDE. R. S. Mani, M. Subramanian, and V. K. Iya (Atomic Energy Establishment, Trombay, India). Indian J. Technol., 1: 24-6(Jan. 1963).

A simple and rapid method for the routine production of Cl^{36} and carrier-free S^{35} from pile-irradiated potassium chloride is reported. A dilute hydrochloric acid solution of irradiated potassium chloride is passed through a column of chromatographic grade alumina, when S^{35} is quantitatively retained on the column and potassium chloride passes down. Sulfur-35 is eluted out of the column with dilute ammonia solution, and traces of aluminum and any heavy metal impurities present in the eluate are separated out by precipitation as hydroxides. Chlorine-36 is recovered from the effluent potassium chloride solution by distillation with dilute sulfuric acid. (auth)

14252 THE EXCHANGE OF PLUTONYL AND SOLVENT WATER OXYGEN. B. J. Masters and S. W. Rabideau (Los Alamos Scientific Lab., N. Mex.). Inorg. Chem., 2: 1-5 (Feb. 1963). (LADC-5346)

Rates of exchange of plutonyl oxygen and H_2O^{18} were measured in perchloric acid solutions at 23 and 83°C. It was found that the intrinsic exchange reaction is slow, $t_{\frac{1}{2}} > 10^4$ hr. Since the exchange reaction is accelerated in the presence of lower oxidation states of Pu, chlorine was used in exchange runs to maintain the Pu in the plutonyl condition. The longer half times associated with lower plutonyl ion concentrations in the exchange solutions are interpreted in terms of a radioinduced exchange process. (auth)

14253 POLAROGRAPHY OF THE RARE EARTH ELEMENTS AND OTHER INORGANIC SUBSTANCES IN ACETONE AS SOLVENT. J. F. Coetzee and Wei-san Siao (Univ. of Pittsburgh). Inorg. Chem., 2: 14-19(Feb. 1963).

Cations, particularly the solvated proton and metal ions of high charge type, generally are reduced at less negative potentials in acetone than in water. Half-wave potentials (vs the aqueous saturated calomel electrode) obtained at the dropping mercury electrode in 0.1 M tetraethylammonium perchlorate as supporting electrolyte were (in volts, with an asterisk denoting a reversible or near-reversible electroreaction): oxygen, –0.92 and –1.4; sodium, –1.92; potassium, –1.97*; rubidium, –1.97*; magnesium, –1.75; cadmium, –0.18*, silver, more positive than the anodic discharge potential of mercury (+0.68 v); copper(II) → copper(I), +0.53*; copper(I) → copper amalgam, +0.31*; samarium, europium, and ytterbium, a first wave (III → II) at –1.13*, –0.03, and –0.71*, respectively, and a second (2-electron) wave at –1.70, –1.79, and –1.71, respectively. All other rare earth elements gave only one (3-electron) wave near –1.4 v, with some irregularities, shown to be caused by solvolysis effects. It is likely that the second (2-electron) wave of samarium, europium, and ytterbium, as well as the single (3-electron) wave of the remaining rare earth elements, is caused by hydrogen evolution, rather than by amalgam formation. It is shown that the overpotential of hydrogen on mercury is approximately 0.8 v smaller in acetone than in water. Iodide ion gave two anodic waves at the dropping mercury electrode, corresponding to successive formation of HgI_3^- and HgI_2, with half-wave potentials equal to –0.37* and +0.20* v. (auth)

14254 THE MASS SPECTRA OF VOLATILE HYDRIDES. I. THE MONOELEMENTAL HYDRIDES OF THE GROUP IVB AND VB ELEMENTS. Fred E. Saalfeld and Harry J. Svec (Iowa State Univ., Ames). Inorg. Chem., 2: 46-50(Feb. 1963).

The mass spectra of SiH_4, GeH_4, SnH_4, PbH_4, PH_3, AsH_3, SbH_3, and BiH_3 were obtained. Fragment ions, after careful test, were found to have negligible excess kinetic energy. The average M–H bond energies and the ΔH_f^0 obtained from appearance potential data agree well with other values when they exist. (auth)

14255 THE MASS SPECTRA OF VOLATILE HYDRIDES. II. SOME HIGHER HYDRIDES OF THE GROUP IVB AND VB ELEMENTS. Fred E. Saalfeld and Harry J. Svec (Iowa State Univ., Ames). Inorg. Chem., 2: 50-3 (Feb. 1963). (IS-528)

The mass spectra of Si_2H_6, $Ge_2^{74}H_6$, $Ge_2^{74}H_3$, $Sn_2^{120}H_6$, P_2H_4, As_2H_4, and Sb_2H_4 were obtained. The average M–M bond energies and the ΔH_f^0 were calculated from appearance potential data. (auth)

14256 THE KINETICS OF THE DISPROPORTIONATION OF AMERICIUM(V). James S. Coleman (Los Alamos Scientific Lab., N. Mex.). Inorg. Chem., 2: 53-7(Feb. 1963). (LADC-3670)

Use of the isotope Am^{243} ($T_{\frac{1}{2}}$ = 7951 years) made possible the first observations of the disproportionation of Am(V) unobscured by the effects of radiolysis. The net reaction is: $3AmO_2^+ + 4H^+ \rightarrow 2AmO_2^{2+} + Am^{3+} + 2H_2O$. The rate at 75.7° in perchlorate solutions of ionic strength 2 M is given by $-d(AmO_2^+)/dt = k_2(H^+)^2(AmO_2^+)^2 + k_3(H^+)^3(AmO_2^+)^2$, with k_2 and k_3 equal to 7.0×10^{-4} M^{-3} sec^{-1} and 4.6×10^{-4} M^{-4} sec^{-1}, respectively. Estimation of the difference in the entropies of activation for the parallel paths suggested by this rate law combined with rate measurements at 60 to 85° gives $\Delta H_2^\ddagger$ = 16.5 kcal/mole, $\Delta S_2^\ddagger$ = –26 eu, $\Delta H_3^\ddagger$ = 10.5 kcal/mole, $\Delta S_3^\ddagger$ = –44 eu. At 75.7°, the rates in 2 N HNO_3, HCl, and H_2SO_4 are 4.0, 4.6, and 24 times as great as that in 2 N $HClO_4$. At room temperature, the reaction rate increases by a factor of 450 going from 3 to 8 M perchloric acid. Observation of the oxidation of Am(III) by Am(VI), the reverse of the disproportionation reaction, is also reported. (auth)

14257 PREPARATION AND PROPERTIES OF AMERICIUM(VI) IN AQUEOUS CARBONATE SOLUTIONS. J. S. Coleman, T. K. Keenan, L. H. Jones, W. T. Carnall, and R. A. Penneman (Los Alamos Scientific Lab., N. Mex. and Argonne National Lab., Ill.). Inorg. Chem., 2: 58-61(Feb. 1963). (LADC-5452)

Hexavalent americium was conveniently prepared as a soluble, red-brown complex in aqueous Na_2CO_3 or $NaHCO_3$ by O_3 or $S_2O_8^{2-}$ oxidation of americium in lower valence states. The solutions in 0.1 to 0.5 M $NaHCO_3$ were stable at 90° to reduction by H_2O, Cl^-, and Br^-, but were readily reduced by I^-, N_2H_4, H_2O_2, NO_2^-, and NH_2OH. Reduction by water occurred at 90° in 2 M Na_2CO_3. The spectra of Am(VI) in the 500 to 1300 mμ region were markedly different in carbonate solutions than in acid. The infrared spectra of solid sodium americyl(VI) carbonates established the presence of the O–Am–O group in the carbonate complex. Based on the properties of Am(VI) in carbonate solution, a new procedure for the preparation of Am(V) free from traces of Am(III) and a useful process for the separation of americium and curium are reported. (auth)

14258 CHELATES OF β-DIKETONES. V. PREPARATION AND PROPERTIES OF CHELATES CONTAINING STERICALLY HINDERED LIGANDS. George S. Hammond, Derek C. Nonhebel, and Chin-hua S. Wu. (Iowa State Univ., Ames and California Inst. of Tech., Pasadena). Inorg. Chem., 2: 73-6(Feb. 1963).

A number of metal chelates containing the anions of β-diketones as ligands were prepared. Various synthetic procedures are described and physical characteristics are reported. (auth)

14259 COMPLEXES OF THE RARE EARTHS. III. MIXED COMPLEXES WITH N-HYDROXYETHYLETHYLENEDIAMINETRIACETIC ACID. Larry C. Thompson and Judith A. Loraas (Univ. of Minnesota, Duluth). Inorg. Chem., 2: 89-93(Feb. 1963).

The tendency of the 1:1 rare earth-N-hydroxyethylethylenediaminetriacetic acid (Ln(HEDTA)) chelates to form mixed 1:1:1 chelates with glycine, ethylenediaminediacetic acid (EDDA), iminodiacetic acid (IMDA), and N-hydroxyethyliminodiacetic acid (HIMDA) was investigated. Mixed complex formation was found in all cases but formation constants could only be obtained for the IMDA, HIMDA, and some of the EDDA complexes. The mixed complexes were quite stable and the formation constants exhibited trends, which can reasonably be explained by the properties of the ligands and steric factors. Evidence for a coördination number larger than six in the rare earths is summarized and additional evidence is presented, which indicates that in the mixed chelates the rare earths have an expanded coördination number. (auth)

14260 MÖSSBAUER EFFECT IN IRON PENTACARBONYL AND RELATED CARBONYLS. R. H. Herber, W. R. Kingston, and G. K. Wertheim (Rutgers Univ., New Brunswick, N. J. and Bell Telephone Labs., Murray Hill, N. J.). Inorg. Chem., 2: 153-8(Feb. 1963).

Four related iron carbonyls, $Fe(CO)_5$, $Fe_2(CO)_9$, $Fe_3(CO)_{12}$, and $Fe(CO)_4I_2$, were used as stationary absorbers in a Mössbauer experiment in which Co^{57}, diffused into metallic chromium, was employed as a source. All four absorbers showed significant resonance absorption of the 14.4-kev γ-ray of Fe^{57} at 78°K. The observed isomer shifts were interpreted in terms of the chemical bonding in transition metal–carbonyl compounds. The two major Mössbauer parameters (isomer shift and quadrupole splitting) in the case of $Fe(CO)_5$ and $Fe_2(CO)_9$ were in agreement with a trigonal bipyramid structure and a (3,3,3) structure, respectively. The data for $Fe_3(CO)_{12}$ strongly suggested the linear (3,3,3,3) structure and could not be accounted for by the trigonal arrangement of the three iron atoms, which was proposed on the basis of x-ray data. The quadrupole splitting for $Fe(CO)_4I_2$ was essentially independent of temperature in the range 78 to 298°K, in contrast to the large temperature dependences, which were observed for some related Fe(II) compounds. The isomer shift was consistent with an assignment of 2+ for the oxidation state of iron in this compound. (auth)

14261 FUSED SALT SPECTROPHOTOMETRY. IV. URANIUM(IV) IN CHLORIDE MELTS. John R. Morrey (General Electric Co., Richland, Wash.). Inorg. Chem., 2: 163-9(Feb. 1963).

The absorption spectra of UCl_4 in several fused chloride solvents were obtained at various temperatures over the range 300 to 2600 mμ. Comparison with spectra of pure molten and solid Cs_2UCl_6 clearly indicated that the hexachlorouranate(IV) ion occurs in all of the solvents except $ZnCl_2$ and is in equilibrium with another species in the alkali chlorides. The order of stability of UCl_6^{2-} in the various solvents is given by the sequence $CsCl–CsAlCl_4$ = $KCl–KAlCl_4$ > CsCl > KCl > NaCl > $ZnCl_2$. At least one different species occurs in $ZnCl_2$. Comparison with spectra of UCl_4 in the pure molten and solid states provided evidence that all the uranium species detected have a coördination number of six or less. The spectra of U(IV) in $CsCl–AlCl_3$ and $KCl–AlCl_3$ are identical at a given $MCl/AlCl_3$ ratio, but both vary as the ratio varies; they change markedly at the composition corresponding to $MAlCl_4$. Equilibria involving complex ions, which account for this phenomenon, are proposed. Temperature dependence of spectra also is discussed. (auth)

14262 IRON(II) + IRON(III) ISOTOPE EXCHANGE IN PRESENCE OF SULFATE IONS. W. L. Reynolds and S. Fukushima (Univ. of Minnesota, Minneapolis). Inorg. Chem., 2: 176-81(Feb. 1963).

The iron(II) + iron(III) isotope exchange rate was measured in $NaClO_4–HClO_4–Na_2SO_4$ media as a function of sulfate concentration and pH at 25°C. The results were consistent with the hypothesis that exchange in the presence of sulfate can occur by the reactions: $Fe^{2+} + {}^*FeSO_4^+ \rightarrow FeSO_4^+ + {}^*Fe^{2+}$; $Fe^{2+} + {}^*Fe(SO_4)_2^- \rightarrow Fe(SO_4)_2^- + {}^*Fe^{2+}$; $FeSO_4 + {}^*FeOH^{2+} \rightarrow FeOH^{2+} + {}^*FeSO_4$. The reactions were in addition to the reactions that can occur in the absence of sulfate. The rate constants for the three reactions have the values of 693, 1.94×10^4, and 1.3×10^6 l/mole sec, respectively, at an ionic strength of 0.250 M. The first rate constant is dependent on ionic strength whereas the second is independent of ionic strength over the range employed. The third rate constant was not sufficiently accurately determined to tell its dependence on ionic strength. (auth)

14263 COMPOSITION AND STABILITY OF THE CHELATE BETWEEN URANIUM(VI) AND SULFODICHLOROHYDROXYDIMETHYL FUCHSON DICARBOXYLIC ACID (TRISODIUM SALT). Suresh C. Srivastava and Arun K. Dey (Univ. of Allahabad, India). Inorg. Chem., 2: 216-19 (Feb. 1963).

The composition and stability of the uranyl Chrome Azurol S chelate are reported. It was found that the reagent behaves as a colloidal electrolyte. Color formation was observed to be immediate and the absorbance values remained constant at least up to 72 hr. Continuous variation curves at 570 and 585 mμ confirmed the stoichiometry as one UO_2(II) to one Chrome Azurol S. The value of the apparent stability constant for the 1:1 chelate at a pH of 5.0 and temperature of 30°C was 4.5 ± 0.1 and 4.9 ± 0.1 depending

on the method. The corresponding free energy change of formation was −6.2 ± 0.1 and −6.8 ± 0.1 kcal, respectively, at 30°C. Suggestions are given as to the structure of the chelate. (P.C.H.)

14264 COMPLEXES OF THE RARE EARTHS. IV. ELECTROPHORETIC EXAMINATION OF THE HYDROLYSIS OF N-HYDROXYETHYLETHYLENEDIAMINETRIACETIC ACID CHELATES. Larry C. Thompson and James C. Nichol (Univ. of Minnesota, Duluth). Inorg. Chem., 2: 222-4(Feb. 1963).

Electrophoresis experiments were performed on solutions containing the hydrolysis products of La, Nd, Dy, and Yb chelates with N-(hydroxyethyl)ethylenediaminetriacetic acid. The results were consistent with the behavior expected of solutions containing principally a neutral complex and a single negatively charged species, as inferred from titration experiments, and provided good supporting evidence by an independent method for the correctness of conclusions drawn from titration data. In all experiments at pH values where significant hydrolysis would be expected a single moving boundary, proceeding toward the anode, was observed in both descending and ascending limbs. The mobilities calculated from boundary velocities and conductances of the appropriate solutions were about 1×10^{-4} cm^2 $volt^{-1}$ sec^{-1} for the four chelates. No boundaries moving toward the cathode were observed at any pH investigated. (P.C.H.)

14265 XENON HEXAFLUORIDE. Francis B. Dudley, Gary Gard, and George H. Cady (Univ. of Washington, Seattle). Inorg. Chem., 2: 228-9(Feb. 1963).

The effects of pressure and temperature on xenon–fluorine mixtures were studied. Xe–F mixtures were introduced into a 1500-cc prefluorinated nickel vessel and the pressure-temperature dependence followed from room temperature up to 720°K. The mixtures followed ideal gas behavior up to 390°K, when a pressure decrease began to occur. The pressure decreased rather rapidly in the temperature range 480 to 520°K until the total decrease was about 2.5 times the pressure which would have been due to xenon alone. Above 560°K the rate of increase in pressure with temperature was abnormally large, thereby suggesting the dissociation of a molecular species. At about 710°K the pressure vs temperature curve merged into that expected for a mixture of F_2 with XeF_4. Empirical formulas of xenon fluoride formed at 500, 150, and 25 atm were also calculated. (P.C.H.)

14266 THE PREPARATION AND STRUCTURE OF LUTETIUM DIBORIDE, SCANDIUM DODECABORIDE AND LUTETIUM ANTIMONIDE. Maria Przybylska, Allan H. Reddoch, and George J. Ritter (National Research Council, Ottawa). J. Am. Chem. Soc., 85: 407-11(Feb. 20, 1963).

LuB_2 was prepared by heating Lu_2O_3 and B at about 1500°. It has the AlB_2 structure with parameters a_0 = 3.246 ± 0.001 Å and c_0 = 3.704 ± 0.001 Å. ScB_{12}, prepared by heating Sc_2O_3 and B, has the UB_{12} structure with a lattice parameter of a_0 = 7.422 ± 0.002 Å. LuSb, prepared by heating the elements, has the NaCl structure with a lattice parameter of a_0 = 6.0555 ± 0.0003 Å. The errors quoted apply to the samples used and do not allow for the possible effects of impurities or non-stoichiometry in these samples. The reported existence of LuB_6 and ScB_6 could not be verified. Attempted preparations of the two compounds yielded mixtures of LuB_4 and LuB_{12}, and ScB_2 and ScB_{12}, respectively. (auth)

14267 A RAPID AND QUANTITATIVE EXCHANGE OF THE BORON HYDROGENS IN TRIMETHYLAMINE BORANE WITH D_2O. Robert Earl Davis, Ann Elizabeth Brown, Rudolf Hopmann, and Charles L. Kibby (Purdue Univ., Lafayette, Ind.). J. Am. Chem. Soc., 85: 487(Feb. 20, 1963).

New procedures are given that should greatly facilitate the synthesis of compounds labeled with deuterium or tritium with known stereochemistry to aid in the elucidation of reaction mechanisms. The homogeneous reaction of $(CH_3)_3NBH_3$ in dilute deuteriochloric acid first produces $(CH_3)NBD_3$, which can be extracted with ether or allowed to hydrolyze slowly to produce pure deuterium gas. Also the hydrolysis of trimethylamine borane-$\underline{d}_3$ in HCl produces only hydrogen gas. Large amounts of trimethylamine-$\underline{d}_3$ are obtained readily using this procedure. (P.C.H.)

14268 ION ASSOCIATION ON POLYVALENT SYMMETRICAL ELECTROLYTES. V. THE CONDUCTANCE OF SOME ALKALINE EARTH m-BENZENEDISULFONATES IN WATER AT 25°. Gordon Atkinson and Sergio Petrucci (Univ. of Maryland, College Park). J. Phys. Chem., 67: 337-9(Feb. 1963).

The electrical conductances of Mg, Ca, Sr, and BaBDS were measured in water at 25°. Analysis of the data by the Fuoss-Onsager equation shows all four salts to be essentially unassociated. The necessity of a term of $(O)C^{\frac{3}{2}}$ in the equation for concentrations $>2 \times 10^{-3}$ molar is pointed out. An alternative method of checking the Λ^0 value and evaluating higher term contributions is proposed. (auth)

14269 THERMODYNAMIC PROBLEMS ON THE REDUCTION OF RARE-METAL OXIDES. Yuan-hsi Chou. K'o Hsueh T'ung Pao, No. 1, 30-3(1962).

The preparation of such rare metals as Th, U, V, Zr, Nb, Tl, Ta, and Ti, by reduction of the oxides is discussed. The general reaction equation for reduction is: $R_xO_y + zM = M_zO_y + xR$. Where R_xO_y is the oxide of the metal; M is the metal reducing agent. If solubility of oxygen in the metal is considered, the equation may be written following the steel deoxygenation reaction as $y\underline{O} + z\underline{M} = M_zO_y$. As few activation coefficients of oxygen and metallic reducing agents in rare metals have been determined; the change of free energy in the reactions is unknown. The free energy vs temperature curve can be obtained only by calculation. It was concluded that the steel deoxidation theory can be applied successfully to the reduction of rare metal oxides. Three types of rare metal oxides were determined according to ease of preparation. (P.C.H.)

14270 ELECTRON DIFFRACTION STUDY OF THE OXIDATION OF NIOBIUM. J. J. Trillat and L. Tertian (Centre National de la Recherche Scientifique, Bellevue, France). Mem. Sci. Rev. Met., 60: 23-9(Jan. 1963). (In French)

Oxidation, in air and under reduced pressure, of thin layers of crystallized niobium is studied by electron diffraction technique. Under the same conditions, surface oxidation on small massive metal plates is examined. The formation of oxide NbO_2, of different types of Nb_2O_5, and also the formation in a high vacuum of carbide NbC are described. (auth)

14271 COPRECIPITATION OF RADIONUCLIDES WITH TITANIUM DIOXIDE HYDRATE. H. W. Levi (Hahn-Meitner-Institut für Kernforschung, Berlin). Nukleonik, 4: 319-23(Dec. 1962). (In German)

The coprecipitation of radionuclides with TiO_2 hydrate was studied with respect to the possibility of fixing radioactive precipitates in TiO_2 or titanates. In the coprecipitation of carrier-free radionuclides, TiO_2 hydrate shows an excellent adsorptive capacity. The observed pH dependence is typical for adsorptive precipitation on oxide hydrates. Precipitation in the range of macroconcentration was in-

vestigated for Sr^{89}, Ce^{144}, and Zr^{95} and for Sr^{89} in the presence of Ca or Al. Deterioration of the decontamination factor with increasing ion concentrations could be compensated for by simultaneous direct precipitation of the interfering carrier or foreign ion as the carbonate or oxalate. $TiOK_2(C_2O_4)_2$ appears to be an especially suitable precipitation medium. The presence of Zr and Al in macroconcentrations does not interfere with the precipitation. (tr-auth)

14272 ON THE INTENSITY AND SHAPE OF NUCLEAR QUADRUPOLAR SIGNALS. A. Carelli, E. Grossetti, and M. Marinaro (Università, Naples). Nuovo Cimento (10), 26: 1144-52(Dec. 16, 1962). (In English)

Amplitude and shape measurements of nuclear quadrupole resonance pertaining to samples of paradichlorobenzol prepared in a different way are presented. Furthermore the intensity behavior of the quadrupolar signal in relation to the impurity of the crystal was studied. (auth)

14273 Cu-DOPING IN THERMAL TREATMENT OF SOME ALKALI HALIDE SINGLE CRYSTALS. A. Levialdi and G. Spinolo (Università, Milan and Istituto Nazionale di Fisica Nucleare, Milan). Nuovo Cimento (10), 26: 1153-63(Dec. 16, 1962). (In English)

Certain types of thermal treatments cause impurities, in particular Cu, to penetrate the crystal lattice. In order to magnify the effect, Cu was incorporated either by diffusion or by adding the appropriate copper halide in the molten state and then growing the crystal by the Kyropoulos method. The absorption and emission spectra of various alkali halides, obtained either by exciting in the characteristic Cu absorption band or by x-raying, were examined at RT and LNT. A table summarizing various authors' measurements is included, and a plausible process of emission is considered. (auth)

14274 ELECTRON SPIN RESONANCE STUDIES OF THERMAL EFFECTS IN IRRADIATED AMINO ACIDS. J. Rotblat and J. A. Simmons (St. Bartholomew's Hospital Medical Coll., London). Phys. Med. Biol., 7: 499-504(Feb. 1963).

Radicals induced by irradiation of glycine with high energy electrons were investigated by the electron spin resonance technique. At a dose rate of 130 kr/sec it was found that an exposure to doses greater than 50 Mr leads to a decrease in the number of radicals with increasing dose. The shape of the signal was also found to change. By heating and cooling the samples during irradiation it was shown that the effects observed were due to thermal annealing. Possible theoretical explanations are discussed. (P.C.H.)

14275 THE BEHAVIOUR OF RECOIL ATOMS IN IONIC SOLIDS. J. S. Anderson (National Chemical Lab., Teddington, Middx, Eng.), D. J. M. Bevan, and J. P. Burden. Proc. Roy. Soc. (London), Ser. A, 272: 15-32(Feb. 19, 1963).

The rate of escape of Rn^{220} from solids containing radiothorium depends upon both recoil and diffusion and is steady at any temperature if the distribution of radioactive material remains unchanged. At very high temperatures the emanating power of ThO_2 (and other oxides) increases with time at constant temperature; the emanating power-temperature characteristics eventually resemble those of a solid with a surface source of thoron. The enhancement of emanating power decays with time in such a way as to prove that Ra^{224} is no longer uniformly distributed, although the distribution of the parent Th^{228} is unchanged; the Ra^{224} atoms, formed by recoil from Th^{228}, migrate during their lifetime to trapping sites which, in this case, are on the surface. Similar effects are found with $BaThO_3$ and BaF_2, even though Ra^{224} can replace Ba isomorphously; these compounds are anionic conductors and have only a low concentration of vacant cation sites at high temperatures. If (e.g., in BaO) vacant sites capable of accepting large cations are present in high concentration, the recoil atoms are trapped and retained in uniform distribution. (auth)

14276 CO-PRECIPITATION OF Ce AND K_2SO_4 CRYSTALS. I. INVESTIGATION OF Ce IN K_2SO_4 SOLUTIONS. S. G. Babayan, I. V. Melikhov, and M. S. Merkulova. Radiokhimiya, 4: 381-7(1962). (In Russian)

Diffusion coefficients of Ce and SO_4^{2-} in neutral and acid K_2SO_4 solutions were calculated, and ionic radii in solutions of various composition are determined. It was found that $CeSO_4^+$ compounds are the most probable form in neutral K_2SO_4 solution and $Ce(NO_3)_3$ in saturated K_2SO_4 in 1.5N HNO_3. (R.V.J.)

14277 ADSORPTION OF VARIOUS SUBSTANCES ON RADIOACTIVE BARIUM SULFATE. L. D. Belyakova, V. V. Gromov, A. V. Kiselev, and V. I. Spitsyn. Radiokhimiya, 4: 410-21(1962). (In Russian)

Studies of argon, benzene, hexane, nitrogen, and methanol adsorption on non-radioactive and three radioactive specimens of barium sulfate showed that the presence of SO_4^{2-} contributes to the surface heterogeneity of $BaSO_4$. It was found that vapor adsorption depends on the SO_4^{2-} treatment temperature. Evacuation of specimens at 200 to 400°C to low pressure results in a sharp drop in hexane, benzene, and menthol adsorption and strong changes in the isotherms. The surfaces of specimens evacuated at 400°C are more uniform than those pumped out at 200°C. Adsorption does not depend on the specimen activity. (R.V.J.)

14278 COMPLEX FORMATION OF Pa WITH MONODI-, AND POLYCARBONIC ACIDS. I. COMPLEX FORMATION OF PROTACTINIUM WITH LACTIC ACID. I. Geletseanu and A. V. Lapitskii. Radiokhimiya, 4: 421-6(1962). (In Russian)

Complex formation and behavior of Pa with lactic acid were studied using Pa^{233}, and the instability constant of the compound was calculated. (R.V.J.)

14279 DETERMINATION OF THE COMPOSITION AND STABILITY CONSTANTS IN COMPLEX COMPOUNDS BY MEANS OF ELECTROMIGRATION METHOD. I. DETERMINATION OF THE COMPOSITION AND STABILITY OF ZIRCONIUM OXALATE COMPLEXES. V. P. Shvedov and E. I. Maslov. Radiokhimiya, 4: 427-34(1962). (In Russian)

Studies were made of zirconium oxalate composition and stability, and it is shown that applications of the electromigration method are limited. It is shown that in oxalate-zirconium complexes with 5×10^{-5} M and oxalate-zirconium molar ratios less than 100, the number of oxalate groups is limited to four. Stability constants are calculated for zirconium-oxalate complexes in a medium with pH = 1.824. (R.V.J.)

14280 ON THE EQUIVALENCE OF U ATOMS IN MIXED URANIUM OXIDES. N. I. Blinova and Yu. M. Tolmacheva. Radiokhimiya, 4: 447-51(1962). (In Russian)

The valence of U atoms in U_3O_8 was analyzed by means of U_3O_8 dissolution in various acids and by synthesis of U^{233}-labeled UO_2 and UO_3. The scheme and composition of mixed oxide reactions with labeled UO_3 and UO_2 were analyzed and the α activity of reaction products was measured. The results were not conclusive. (R.V.J.)

14281 THE INFLUENCE OF MEDIA ON THE U(IV) OXIDATION BY CHLORATE. L. A. Fedorova and E. A. Kanevskii. Radiokhimiya, 4: 502-4(1962). (In Russian)

An analysis of U(IV) oxidation by potassium chlorate in acetic acid containing various water additions showed that unbroken chloric acid molecules are responsible for the initial oxidation. The rate of U(IV) oxidation by chlorate in acetic acid with 8% water is increased by a factor of 1000 in comparison with oxidation in aqueous solution. Studies of the reaction mechanism confirm the oxidation inhibiting effect of water. (R.V.J.)

14282 ON UTILIZATION OF Sr^{89} AND $Sr^{90} + Y^{90}$ IN DIRECT RADIOMETRY. Yu. V. Egorov, V. M. Nikolaev, E. I. Krylov, and E. V. Tkachenko. Radiokhimiya, 4: 516-18(1962). (In Russian)

A method is suggested for utilizing $Sr^{89} + Sr^{90} + Y^{90}$ for direct radiometric determination of strontium distribution between two immiscible phases. (R.V.J.)

14283 THERMODYNAMIC PROPERTIES OF SOME FRANCIUM COMPOUNDS. G. A. Krestov. Radiokhimiya, 4: 685-90(1962). (In Russian)

The change of enthalpy, ΔH, may be determined for the formation of the gaseous Fr ion by several methods which yield sufficiently close values; L. Pauling's formula (The Nature of the Chemical Bond, third ed., p.509) was found particularly suitable, regarding the element as a heteropolar compound. The enthalpy of formation of the gaseous ions was calculated to be 106.8 kcal/mole which agrees well with the value obtained by Krasnov (Radiokhimiya 2: 668(1960) No. 6). The values of the enthalpy of formation of a large number of Fr compounds in various states of aggregation were tabulated. The heat of sublimation of metallic Fr was obtained from the enthalpy of formation of the gaseous Fr ion and the first ionization potential. A value of 1.78 Å was used for the ionic radius in the calculation of the crystal lattice energy. Analysis of the experimental material available in the literature indicated that there is a correlation between the crystal lattice energy and the bond energy of the gaseous salts. The change of enthalpy during the hydration of the Fr ion may be expressed by the equation $\Delta H_{hydr.} = (165.5 \cdot Z^2)/(r + 1)$ where Z designates the ion charge, r the ionic radius, while 1 is an additive term for the cation, in this case being 0.8. The entropy of the aqueous ion is +33.2 ev. (TTT)

14284 THERMODYNAMIC PROPERTIES OF SOME ASTATINE AND POLONIUM COMPOUNDS. G. A. Krestov. Radiokhimiya, 4: 690-6(1962). (In Russian)

A computing technique was used for determining the thermodynamic properties of At and Po. The atomic radii in gaseous molecules were calculated at 2.07 Å for Po^{2-} and 1.97 Å for At^-, thus being close to the values reported by W. H. Zachariasen (in the book, The Actinide Elements, edited by G. T. Seaborg and J. J. Katz), and L. Genov (Zhur. Obshchei Khim., 29: 689(1959) No. 2). The crystal lattice energies, entropies and the interionic distances of the gaseous polonide and astatinide molecules from the alkali and alkali earth elements were also calculated. The change of the enthalpy in the case of the formation of the gaseous cation was determined from the enthalpy of formation of the gaseous At^- and Po^{2-} and the electric affinity, estimated at 68 and 81 kcal/mole, respectively, by extrapolating the corresponding values of the halide series. The entropy of aqueous At^- and Po^{2-} was found to be 30.0 and 6.0 eu, respectively. Calculation of the enthalpy of formation of the gaseous alkali and alkaline earth astatinides from the bond energy of the gaseous molecules yielded the following values: NaAt-112; KAt-103; RbAt-99; CsAt-95; FrAt-93 kcal/mole. The thermodynamic potential of the At^-_{aq} ion was estimated at 7.1 kcal/mole. The oxidation-reduction potentials of Po in aqueous solutions are not known with the desired accuracy. (TTT)

14285 ALKALI HYDRIDE MOLECULES: POTENTIAL ENERGY CURVES AND THE NATURE OF THEIR BINDING. Yatendra Pal Varshni (National Research Council, Ottawa) and Ramesh Chandra Shukla. Rev. Mod. Phys., 35: 130-44(Jan. 1963).

Investigation of the potential energy curves of the alkali hydride molecules is reviewed. Values of the rotational constant, vibrational constant, and the ionic binding energy are calculated using seven ionic potentials, and the results are compared. The nature of the binding is examined in terms of classical models and quantum mechanical calculations. (D.C.W.)

14286 XENON DIFLUORIDE AND THE NATURE OF THE XENON-FLUORINE BOND. P. A. Agron (Oak Ridge National Lab., Tenn.), G. M. Begun, Henri A. Levy, A. A. Mason, C. G. Jones, and D. F. Smith. Science, 139: 842-4 (Mar. 1, 1963).

Xenon reacts with fluorine to form XeF_2 which can be isolated before it reacts with fluorine to form XeF_4. The linear configuration of XeF_2 with the 2.00-A bond length and the vibrational force constants support the assignment of 10 electrons to the valence shell of xenon. Similar arguments support the assignment of 12 and 14 valence electrons respectively to xenon in XeF_4 and XeF_6. (auth)

14287 LIQUID SEPARATIONS IN THE SYSTEMS RARE EARTHS-SiO_2. N. A. Toropov and I. A. Bondar. Silikat Tech., No. 4, 137-9(1962).

Experiments concerning silicates of rare earths and phase diagrams of binary systems R_2O_3-SiO_2 (R = La, Sm, Y, Yb, and others) were carried out. Critical separation temperatures of all tested systems were between 2050 and 2200°C. The primary crystal phase precipitating below the separation area consisted of cristobalite. A previous explanation for systems with bivalent cations can be extended to the trivalent cations of rare earths. The area of separation becomes larger during a transition from an element with large ion radius (La, separation starts at 77 mole % SiO_2) to an element with smaller ion radius (Yb, separation starts at 73.7 mole % SiO_2). The binding force of the tested systems was between 3/6 and 3/8. If the number of oxygen atoms (N_0) is known, the formula for the composition limit of a modifier-rich batch for trivalent modifier cations is $R_2O_3(N_0 - 1.5/2)SiO_2$. (P.C.H.)

14288 VIBRATIONAL SPECTRA AND FORCE CONSTANTS OF THE HEXACARBONYLS OF CHROMIUM, MOLYBDENUM AND TUNGSTEN. Llewellyn H. Jones (Los Alamos Scientific Lab., N. Mex.). Spectrochim. Acta 19: 329-38(1963). (LADC-5371)

The infrared absorption spectra of the hexacarbonyls of Cr, Mo, and W were observed in the gaseous and solid states. Eleven of the thirteen fundamental frequencies of each were assigned. Force constants were calculated using a resonance interaction potential function. The order of metal-carbon force constants is $F_{WC} > F_{CrC} > F_{MoC}$. For these three hexacarbonyls, it is found that a higher metal-carbon force constant is accompanied by a lower CO force constant, indicating a decrease in metal-ligand π bonding in the same order as the metal-carbon force constants. The various calculated interaction constants are discussed. They all have reasonable values except the non-coplanar MCO, MCO bending interaction constants, which are unexpectedly large. The results of this work support the use of the resonance interaction valence force field for molecules of this sort. (auth)

14289 ENTHALPY AND HEAT OF DISSOCIATION OF LOWER Hf AND Zr CHLORIDES. L. P. Ruzinov and S. F. Belov. Tsvetn. Metal., No. 9, 85(Sept. 1962). (In Russian)

Enthalpy and heat of dissociation of lower Hf and Zr chlorides at 900 to 1400°K are presented. (R.V.J.)

14290 PRASEODYMIUM AND NEODYMIUM SULFIDES. G. V. Samsonov and S. V. Radzikovskaya. Ukr. Khim. Zh., 28: 444-5(1962).

Technical grade Pr and Nd monosulfides were prepared in a two-step reaction. In the first step, Pr_6O_{11} and Nd_2O_3 were converted to the sesquisulfides by reaction with dried H_2S at 1000 to 1100°C. In the second step, Pr and Nd sesquisulfides were reacted as follows at 1650°C in vacuum (10^{-2} mm Hg): $2Me_2S_3 + Me_2O_3 + 3C = 6MeS + 3CO$. In this reaction it was found that the sesquisulfide must be charged in a 60 to 70% excess over the stoichiometric amount. The excess can be present at the onset or added after a period of preheating. The need for the presence of an excess in the case of CeS but not of LaS is explained by the formation of the oxysulfides or of stable solid solutions of the lower oxides of Ce, Pr, and Nd in the sulfides. The existence of only one electron in the 5d orbital of the La atom permits the prediction of an easy preparation of Ga, Tb, and Lu monosulfides without the use of an excess of Me_2S_3. (P.C.H.)

14291 ISOTOPIC EFFECTS IN THE STRUCTURAL PROPERTIES OF SOLIDS. V. S. Kogan. Usp. Fiz. Nauk, 78: 579-617(Dec. 1962). (In Russian)

In general, the lattice parameter of a compound decreases when hydrogen is replaced by deuterium. Lattice parameters are given and compared for the following pairs: HfH_2 and HfD_2, NH_4Cl and ND_4Cl, NH_4Br and ND_4Br, NH_4I and ND_4I, KH_2PO_4 and KD_2PO_4, KHF_2 and KDF_2, $CO(NH_2)_2$ and $CO(ND_2)_2$, and various carboxylic and hydroxy compounds. The replacement of hydrogen by deuterium generally results in a rise of the linear expansion temperature coefficient. If a polymorphic transformation is involved, this replacement causes a shift in the critical temperature of the transformation. The low-temperature transformation of the ammonium halides is discussed. After reviewing the equipment required to determine lattice parameters at liquid hydrogen or helium temperatures, the various transitions and lattice parameters are given for He^3, He^4, Li^6, Li^7, Ne^{20}, Ne^{22}, Ni^{58}, Ni^{64}, and the hydrogen isotopes. Theoretical explanations of the isotopic effect in solids are based on the difference in zero energies for two isotopes that differ only in mass. The differences in lattice energies are given as a function of temperature and various binding energies for a number of isotopes. Phase diagrams are given for the hydrogen isotopes. (119 references.) (TTT)

14292 THE TYPE OF WATER BONDS IN THE URANIUM TRIOXIDE–WATER SYSTEM. Einhard Schwarzmann and Oskar Glemser (Universität, Göttingen, Ger.). Z. Anorg. Allgem. Chem., 315: 305-8(July 1962). (In German)

The kind of water bonding in aquoxides in the system UO_3-H_2O was investigated by means of infrared and nuclear magnetic resonance spectra. The measurements obtained are only compatible with the presence of the hydroxides $U_2O_5(OH)_2$ and $UO_3(OH)_2$ (2 polymorphic modifications), and the existence of a hydroxide hydrate $UO_2(OH)_2 \cdot H_2O$. (auth)

14293 CONDUCTOMETRIC STUDIES ON PRECIPITATION OF THORIUM AS SELENITE. V. D. Anand, B. Srinivasa Achar, and G. S. Deshmukh (Banaras Hindu Univ., India). Z. Anorg. Allgem. Chem., 315: 309-14(July 1962). (In English)

A conductometric study on the precipitation of thorium as selenite is described. Both direct and reverse conductometric titration procedures were shown to be feasible over the range 0.02 to 0.002 M thorium. The effect of addition of ethanol was also investigated, and it was shown that only the normal selenite with a Th : Se ratio of 1 : 2 is formed in aqueous solutions. In alcoholic medium the ratio is between 1 : 2 and 1 : 1.4. (auth)

14294 INVESTIGATIONS ON ZIRCONIUM COMPOUNDS OF LOW VALENCES. I. PREPARATION OF PURE ZIRCONIUM TRIBROMIDE. H. L. Schlaefer and H. Skoludek (Universität, Frankfurt am Main). Z. Anorg. Allgem. Chem., 316: 15-24(July 1962). (In German)

Pure $ZrBr_3$ was prepared by reaction of finely powdered zirconium metal with $ZrBr_4$. (auth)

14295 ON THE FLUORITE PHASE IN THE SYSTEM $CdO-UO_3-O_2$. C. Keller (Kernforschungszentrum Karlsruhe, Ger.). Z. Anorg. Allgem. Chem., 317: 241-4(1962). (KFK-123). (In German)

A fluorite phase of the composition $(CdO)_xUO_{2+x}$ with x reaching a maximum value of 0.43 ± 0.01 is reported. Its lattice parameter varies as a linear function of x. (auth)

14296 INFORMATION ON THE NITRIDES OF THE CERIUM EARTHS. Ulrich von Essen and Wilhelm Klemm (Universität, Munster, Ger.). Z. Anorg. Allgem. Chem., 317: 25-34(Aug. 1962). (In German)

Magnetic measurements demonstrate that in CeN the majority of the Ce particles are in the tetravalent state and in PrN a considerable number of Me^{4+} ions are present. With increasing temperature the percentage of Me^{3+} ions rises. Therefore, the coefficient of thermal expansion of CeN is considerably higher and that of PrN is somewhat greater than that of LaN. All nitrides of the rare earth metals are metallic. The electric conductivity of CeN at low temperature is considerably lower than that of LaN and PrN; between 210 and 280°K, there is a drop of the resistance of CeN of more than two powers of ten. (auth)

14297 A FLUORITE PHASE IN THE $CdO-UO_3-O_2$ SYSTEM. C. Keller (Technische Hochschule, Karlsruhe, Ger. and Kernforschungszentrum, Karlsruhe, Ger.). Z. Anorg. Allgem. Chem., 317: 241-4(Aug. 1962). (In German)

A fluorite phase of the composition $(CdO)_xUO_{2+x}$, with x reaching a maximum value of 0.43 ± 0.01, is reported. Its lattice parameter varies as a linear function of x. (auth)

14298 PREPARATION AND STRUCTURE OF AN ALUMINUM BERYLLIUM BORIDE. H. J. Becher (Technische Hochschule, Stuttgart). Z. Anorg. Allgem. Chem., 317: 346-52(Sept. 1962). (In German)

In the Al-Be-B system a ternary compound with the idealized composition AlBeB was observed as a fine crystalline dark substance. It crystallizes with an antifluorite structure, with ordered Be and Al atoms in the metal positions. On account of partial formation of mixed crystals with Be_2B, the ratio Be : Al is always greater than one and dependent on the conditions of preparation. The lattice constant varies between 4.952 Å and 4.925 Å. Density, solubility, and the stability of the compound were examined. (auth)

14299 THE EFFECTIVE DIFFUSION IN LIQUID METALS BY ISOTOPE TRANSPORT. A. Lodding and A. Klemm (Technische Hochschule, Goteborg and Max-Planck-Institut für Chemie, Mainz). Z. Naturforsch., 17a: 1085-8(Dec. 1962). (In German)

In isotopic enrichment research on K, Rb, and In using

the Haeffner effect, remarkably large effective diffusion coefficients were observed in horizontal capillaries of 0.6 mm diameter at 10 amp. The cause is, as was shown to be plausible by a calculation, probably the magnetohydrodynamic convection. By reduction of the capillary diameter and current, this and other convection types could be repressed, and the separation method was then suitable for the measurement of the self-diffusion in liquid metals. (tr-auth)

14300 FUEL CELLS AND RELATED RESEARCH. OTS Selective Bibliography. (Office of Technical Services, Washington, D. C.). Dec. 1961. 9p. (SB-447(Rev.)) $0.10 (OTS)

References to 122 reports on fuel cells and related research listed in U. S. Government Research or Technical Translations are included. Domestic research references are listed alphabetically by corporate author, while translations are listed alphabetically by author. (D.C.W.)

Organic Chemistry

14301 (AEC-tr-5641) ON THE ELECTROCHEMICAL BEHAVIOR OF THE ORGANIC SALT SOLUTIONS OF ALIPHATIC TRIALKYLAMINES. C. Botre and G. Scibona (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). Translated for Oak Ridge National Lab., Tenn., from report LTEC/Pr/16. 1962. 16p.

The electrochemical behavior of trialkylamine salts in various solvents was studied to compare long-chain trialkylammonium salts with solid ionic resins on the basis of the electrochemical profile, and to assess the possibility of utilizing these systems as reversible electrodes for ions such as those in the actinide series, which form amine salts. The method is based on determination of the emf through two aqueous solutions separated by the amine salt solution in a water-immiscible organic solvent. It was observed that it is possible to use the experimental liquid systems as reversible electrodes with the ClO_4^-, NO_3^-, and Cl^- anions in the activity interval examined. (J.R.D.)

14302 PREPARATION OF 1-^{13}C ENRICHED BENZONITRILE, MONO-^{13}C ENRICHED BENZENE, AND A MIXTURE OF MONO-^{13}C ENRICHED BENZONITRILES. Boerge Bak, Joern Johs, Christiansen, Leif Lipschitz, and Joergen Tormod Nielsen (Univ. of Copenhagen). Acta Chem. Scand., 16: 2318-20(1962). (In English)

Preparations of 55% C^{13}-enriched $CH_3C^{13}OONa$ (yield 87%), $CH_3C^{13}OOC_2H_5$ (85%), 1-methyl-[1-C^{13}]cyclohexanol-1 (76%), 1-methyl-[1-C^{13}]benzene (85%), [1-C^{13}]benzoic acid (76%), [1-C^{13}]benzonitrile (62%), mono-C^{13} benzene (95%), and a mixture of mono-C^{13} enriched benzonitriles (38%) are described. The purity was checked gas-chromatographically (where ever feasible) and spectroscopically. (auth)

14303 THE HYDROGEN CARRIER TECHNIQUE FOR THE PYROLYSIS OF TOLUENE AND DEUTERATED TOLUENES. R. A. Meyer and J. G. Burr (North American Aviation Science Center, Canoga Park, Calif.). J. Am. Chem. Soc., 85: 478-9(Feb. 20, 1963).

A system is described for the pyrolysis of deuterated and normal toluene using hydrogen as a carrier gas, which produces a simplification in the results. With hydrogen or deuterium as the carrier gas, the quartz tube furnace remains clean, and the only isolable products of the pyrolysis are benzene and methane in approximately equal amounts. No bibenzyl is formed. The conditions used most frequently are: temperature of furnace, 750°C; flow rate of H_2 or D_2 = 90 ml/min; residence time of toluene = 0.7 to 2.0 sec, volume percentage toluene = about 5; sample weight of toluene = 0.22 g (2.4×10^{-3} mole). The mechanism for the formation of methane and benzene is given. (P.C.H.)

14304 THE SYNTHESIS OF LABELED COMPOUNDS AND THE USE OF ISOTOPES IN ORGANIC CHEMISTRY. Vojislav Jezdić and Jelena Rajnvajn. Tehnika (Belgrade), 17: 132-5(1962).

Methods used in the synthesis of labeled organic compounds, the manner of isotope estimation, and the choice of particular isotopes for labeled compound synthesis depending on the purpose for which the compounds will be used are reviewed. The availability of various labeled compounds in Yugoslavia and other countries is discussed. The possibility of using the compounds under existing conditions in Yugoslavia is also considered. (OID)

Radiation Chemistry and Radiochemistry

14305 (AD-278253L) MOLECULAR CHANGES IN POLYAMIDE AND ELASTOMERIC POLYMERS DUE TO NUCLEAR, ULTRAVIOLET AND THERMAL RADIATION. Progress Report No. 5, December 16, 1961–June 15, 1962. G. Hargreaves (Naval Air Material Center. Aeronautical Materials Lab., Philadelphia). June 15, 1962. 12p.

Determination of the molecular changes in polyamide and elastomeric polymers due to nuclear, ultraviolet, and thermal radiation is discussed. Some effects of thermal and γ irradiation on nylon 66 and an experimental fiber HT-1 are shown by means of ultraviolet, visible and infrared spectra, and viscosity measurements. Discussion and interpretation of results are given. (auth)

14306 (AD-278419) RADIATION POLYMERIZATION OF ACETYLENE DERIVATIVES. First Quarterly Technical Report, August 10–November 10, 1961. W. H. Yanko and M. E. Gutzke (Monsanto Research Corp. Dayton Labs., Ohio). Contract NObs-86072. 21p.

Study of the radiation-induced polymerization of acetylene derivatives was initiated. Eighteen acetylene derivatives were radiolyzed; all proved sensitive to gamma radiation. G values for monomer disappearance varied from 10 to 200, indicating a chain process. Of the products, only the polymers from neopentylene dipropiolate and acetylenedicarboxylic acid appear to be high molecular weight. Ultraviolet spectra on the latter showed absorption characteristic of polyenes. (auth)

14307 (AEET/Anal./3) ThB–ThC: A CONVENIENT PAIR OF GENETICALLY RELATED RADIONUCLIDES FOR THE GROWTH DECAY STUDY. P. P. Parekh and M. Sankar Das (India. Atomic Energy Establishment, Trombay). 1962. 16p.

A pair of genetically related radionuclides, ThB (Pb^{212})–ThC (Bi^{212}), is recommended for growth-decay study in radiochemistry because the source of the radionuclides is easily obtained. Also, in a short experiment time, the student can determine the growth of the daughter product, the time of maximum activity of the mixture as well as the daughter, the rate of decay of the system after attaining radioactive equilibrium, and the half life of a simple radioactive decay. The advantage of this pair over the systems in general use is discussed, and the experiment is outlined. (auth)

14308 (AGN-AN-847) HYDRAZINE PROCESS DEVELOPMENT. Interim Technical Engineering Report,

November 1962 through January 1963. H. T. Watanabe, L. G. Carpenter, R. I. Miller, R. L. Pearson, F. R. Standerfer, and H. J. Snyder (Aerojet-General Nucleonics, (San Ramon, Calif.). Contract AF33(600)-42996. 183p. (ASD-TR-7-840A(VIII); AD-297032)

Activities in a program to develop, design, construct, and operate a continuous, in-reactor hydrazine production loop based on fissiochemical processes are reported. Data and information are presented concerning separation of ammonia-hydrazine mixtures, long-term chemical changes in a fissiochemical environment, slurry sampling, sol formation, in-reactor loop fabrication, flux-run results, loop sampling technique development, N-F-O irradiations, urea additive effects, and parametric reactor systems analysis. A side arm was added to the loop gas disengager vessel to allow undisturbed level indication. Operation of a 1-inch ID, packed, distillation column allowed continuous separation of an 88-lot-% N_2H_4 bottoms product from 5 wt% N_2H_4 feed. Continued gamma spectrometry identified $Ce\text{-}Pr^{144}$ and $Cs\text{-}Ba^{137}$ in the BMI capsule contents. Presently scheduled loop operations will simulate the long-term chemical changes incurred by the first 100 hours operation of a typical production reactor. The feasibility of stable UO_2-ammonia sols was indicated. Slurry sampling was developed to ±10% accuracy in fuel concentration determination. Satisfactory filter operation was demonstrated. No colloid formation was noted in the BMI irradiations. Post-irradiation loop disassembly and examination plans were formulated. Fabrication started on most equipment associated with the in-reactor loop. No loop damage will result from the simultaneous loss (improbable) of slurry and coolant water flow. The flux run indicated a peak thermal neutron flux of 8.8×10^{13} n/cm^2-sec in the loop; 65 g UO_2/l of ammonia will generate 15 kw fission power. A liquid sampling unit under development, demonstrated hydrazine concentration reproducibility within 3.5%. A multi-pass, two-column, gas analysis unit was designed. The effect of urea additions on hydrazine yield suggests that NH_2 radicals formed outside the fission fragment tracks destroy hydrazine. Irradiation of various N-F-O systems gave only indirect evidence of product formation. Re-evaluation of ammonia heat transfer data, based on newly acquired thermal conductivity data, supports the Seider-Tate correlation. The drop-out velocity of an ammonia slurry was 5.2 ft/sec at 150°F. The interrelationships among reactor inlet and outlet temperatures, head, flow, pump size and arrangement, and hydrazine production were determined for a typical reactor. (auth)

14309 (BNL-6708) THE RADIATION PROCESSING RESEARCH AND DEVELOPMENT PROGRAM AT BROOKHAVEN NATIONAL LABORATORY. Meyer Steinberg and Bernard Manowitz (Brookhaven National Lab., Upton, N. Y.). Feb. 1963. Contract [AT(30-2)-Gen-16]. 33p.

A review of various ways in which nuclear energy can be used in the chemical process industry is presented. Data are included on aspects of radioinduced polymerization of ethylene. Flowsheets are included for radiochemonuclear, thermochemonuclear, electrochemonuclear, and photochemonuclear reactors. Other information is included on irradiation loops. (J.R.D.)

14310 (BNL-6773) HOT-ATOM CHEMISTRY OF THE SOLID STATE; ITS HISTORY, CURRENT STATUS AND FUTURE PROSPECTS VIEWED IN RELATION TO THE PLANNING OF CHEMICAL RESEARCH PROGRAMS FOR NEW SCIENTIFIC ESTABLISHMENTS CENTERED ABOUT A RESEARCH REACTOR. Garman Harbottle (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract [AT(30-2)-Gen-16]. 34p.

The information is presented in sections on history and status, techniques which can be applied to the study of hot atom chemistry in solids, basic equipment requirements and costs, and manpower requirements. A bibliography of 108 references is included. (J.R.D.)

14311 (IDO-16839) EVALUATION OF RADIATION STABILIZERS FOR TERPHENYL BY HIGH-TEMPERATURE ELECTRON IRRADIATION. H. A. Hartzfeld and R. B. Regier (Phillips Petroleum Co., Bartlesville, Okla.). Jan. 21, 1963. Contract AT(10-1)-1080. 13p.

The effectiveness of additives to reduce radiolytic damage to a mixture of isomeric terphenyls was studied by a series of experiments in which 93 separate compounds were evaluated. The additives were tested at a low concentration (usually 3 mole percent) under irradiation at about 650°F with 6-Mev electrons from the Linac, to a dosage of 5×10^8 rads. Evaluations of the additives were based on comparison with control samples which were always irradiated simultaneously; their effectiveness was judged primarily by the relative polymer production, but relative gas production was also always determined. Results of the experimental work indicate that compounds which are effective to reduce polymerization may be classified into three categories: elemental sulfur, or a variety of compounds containing divalent or tetravalent sulfur, reduces polymer production to 75 to 88% of that in a control sample; fused-ring compounds structurally related to anthracene reduce polymer production to 73 to 89% of that in a control sample; and hydrogenated or partially hydrogenated fused-ring compounds which do not necessarily have the structure of anthracene reduce polymer production to 75 to 93% of that in a control sample. Final evaluation of these additives for reactor use should await supplemental studies of the effect of fast neutron radiolysis. No attempt was made to estimate the economic advantage of using stabilizers to minimize radiation damage. Some areas for future work to elucidate reaction mechanisms are suggested. (auth)

14312 (ORNL-3389) DEVELOPMENT OF A RELIABLE LINE DISCONNECT FOR THE TRANSURANIUM PROCESSING FACILITY. T. S. Mackey (Oak Ridge National Lab., Tenn.). Feb. 18, 1963. Contract W-7405-eng-26. 25p.

Reliable line disconnects are necessary to permit the remote replacement of process equipment in the Transuranium Processing Facility. Two disconnect designs were subjected to several severe tests in order to select the most suitable design. These performance tests demonstrated the superiority of the surface-seal concept over that of the line seal-concept and the reliability of this seal when subjected to misalignment forces, corrosive solutions, rough handling and interchange of mating parts. Tests of Hastelloy C disconnects after heat treatment demonstrated the necessity for joining the disconnect to the process tubing by means other than welding. Several leak-tight joints were made by external mechanical swaging, by external electrical swaging (by the "Magniform" process developed by the General Dynamics Corporation) and by internal rolling. Hastelloy C disconnect samples machined to reasonable machine tolerance established the economic feasibility of the design. (auth)

14313 (SRIA-101) RADIATION STABILITY OF ORGANIC LIQUIDS. Final Summary Report. E. M. Kinderman and A. H. Samuel (Stanford Research Inst., Menlo Park, Calif.). Feb. 15, 1963. For Oak Ridge National Lab. Tenn. Contract AT(04-3)-115. 43p.

Subsystems of possible extractant systems for use in reactor fuel element reprocessing were irradiated and decomposition yields and other effects of radiation were determined. The work performed during this study had two major directions. The first was a study of the radiolysis of the tributylphosphate-kerosene system (Amsco 125-82 was commonly used as the kerosene diluent). The second consisted of brief empirical studies of alternate extractants and of various approaches to avoiding the deleterious aspects of radiation damage. Detailed descriptions of the experiments performed and their interpretations are presented. The first investigation was systematic, beginning with an examination of the radiolysis of pure tributylphosphate and then proceeding successively to examination of the radiolysis of pure materials, anhydrous solutions, and one-phase systems containing water, with and without nitric acid, and the radiolysis of two-phase systems containing either the extractant solution (tributylphosphate-Amsco), salting agent (nitric acid), and water, or the same constituents plus uranyl nitrate. Attempts were made to establish G values (number of molecules produced or destroyed per 100 electron-volts) for the formation of various radiolysis products and for the destruction of extractant and salting agents. The empirical studies covered a wide range of reagent combinations and of treatments designed to improve and extend the effective life of the reagent system. (auth)

14314 (TID-17939) RADIATION CHEMISTRY OF GASES. John E. Willard (Wisconsin. Univ., Madison). [1962]. Contract AT(11-1)-32. 16p.

Discussions are presented concerning the advantages and limitations of gas phase studies in radiation chemistry, observed effects of phase in radiation, hot reactions, reactions of thermal I atoms, HCl catalyzed chain isomerizations, molecular H_2 detachment, fragmentation of charged species, role of excited states, and dissociative electron attachment. (J.R.D.)

14315 (TID-18027) STUDIES OF THE RADIATION CHEMISTRY OF ORGANIC COMPOUNDS. A. METHANOL AND METHANOLIC SOLUTIONS. B. MOLECULAR ORIGINS OF PRODUCTS OF REACTION WITH ATOMIC NITROGEN. Progress Report, February 16, 1962–January 15, 1963. Norman N. Lichtin (Boston Univ.). Jan. 31, 1963. Contract AT(30-1)-2383. 18p.

Progress is reported on radiolysis of methanol, radiolysis of ethanol, and preparations for studying reactions of N with propylene-2-C^{14}. Gamma radiolysis of deaerated and aerated methanol was compared with radiolysis by $B^{10}(n,\alpha)Li^7$ recoils. (M.C.G.)

14316 (USNRDL-TR-607) RAPID RADIOCHEMICAL PROCEDURE FOR ANTIMONY AND ARSENIC. A. E. Greendale and D. L. Love (Naval Radiological Defense Lab., San Francisco). Jan. 17, 1962. 19p. (AD-296435)

A very rapid radiochemical procedure was developed for antimony and arsenic. A sample is added to a 30% solution of H_2SO_4 containing a carrier for antimony or arsenic (or both). This solution is dropped into a flask containing granular zinc at 100°C. The volatile stibine and/or arsine formed is passed through a hot quartz tube and decomposed to the metal, which collects as a metallic mirror on a cooler portion of the quartz tube. This metal is dissolved in H_2SO_4 and assayed. The chemical yield is consistently between 70 and 80%. The time required for separation of the metal from the other elements of a fission product solution is about 10 seconds. The decontamination factors for the antimony procedure are: Mixed fission products (2 weeks old) = 10^5, I = 3×10^4, Te = 4×10^4, Sn = $>10^5$, As = 20-50. The decontamination factors for the arsenic procedure are: Mixed fission products = 10^7, Sb = 2×10^3, Sn = $>10^6$. (auth)

14317 (AERE-Trans-905) EXPLOSIVE REACTIONS CAUSED BY IRRADIATED LIQUID NITROGEN AND OXYGEN. Zen'ichirō Kuri. Translated by D. Jackson from Genshiryoku Kogyo, 7: No. 12, 39-42(1961) (revised by the author, August 1962). 9p.

Results of a series of irradiation experiments with liquid N_2 are presented. Data and information are included on explosions resulting from mixing organic substances with irradiated liquid N_2. Other information is included on irradiation of liquid O_2. Theories concerning the cause of explosive reactions observed with these liquids are discussed. (J.R.D.)

14318 (CEA-tr-X-488) MESURE DU TRITIUM ET DU CARBONE-14 EN PHASE GAZEUSE. (Measurement of Tritium and Carbon-14 in the Gaseous Phase). C. Mantescu and M. Fiti. Translated into French from Acad. Rep. Populare Romine, Studii Cercetari Fiz., 11: 788-98 (1960). 23p.

A study was made of the best conditions for the measurement of T and C^{14} in the gaseous phase, using self-extinction G-M counters. The factors considered were the cathode nature, pressure and nature of transfer gas, pressure of extinction gas, total pressure, operating voltage, plateau length, slope, dead time, background, and efficiency. The experimental data showed that the best solution for the measurement of tritium was a copper cathode counter with the following characteristics: mixture, hydrogen at 200 mm Hg and methylal at 85 mm Hg; plateau length, 110 v; slope, 1.5% for 100 v; dead time, 1.2×10^{-4} sec; and background, 78 pulses/min. The best solution for the measurement of C^{14} was a copper cathode counter containing a mixture of CO_2 at 100 mm Hg and methylal at 80 mm Hg. The plateau length was 350 v; slope, 4.5%; dead time, 1.26×10^{-4} sec; and background, 180 pulses/min. (J.S.R.)

14319 K ABSORPTION SPECTRUM OF THE ELEMENTS Zn, As, Se, Zr, AND Mo IRRADIATED WITH NEUTRONS. D. Bally, L. Benes, N. Iliescu, and Şt. Iorgulescu (Inst. of Atomic Physics, Bucharest). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 13: 443-8(1962). (In Rumanian)

The study of the K absorption discontinuities of Zn, As, Se, Zr, and Mo, made with neutron-irradiated absorbants, established that there is a structure in the discontinuity of Mo, caused by the irradiation. The conditions which the experimental apparatus must satisfy and the absorbant thickness necessary to show this irradiation effect are discussed. (tr-auth)

14320 STANDARDIZATION OF Co^{60} SOURCES BY $\beta-\gamma$ COINCIDENCE METHODS. L. Grigorescu, C. Lazarovici, N. Mateescu, and P. Şandru (Inst. of Atomic Physics, Bucharest). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 13: 579-604(1962). (In Rumanian)

A method perfected for the standardization of Co^{60} sources by using G-M counters is proposed. The manner of measuring correctly the γ background in the counter which measures the β radiation is indicated and numerous corrections are made. (tr-auth)

14321 RECENT DEVELOPMENTS IN ISOTOPE PRODUCTION AND SOURCE FABRICATION. Paul C. Aebersold (U. S. Atomic Energy Commission, Washington, D. C.). Am. J. Roentgenol., Radium Therapy Nucl. Med., 89: 455-69(Mar. 1963).

Progress in isotope production, source fabrication, and future plans is reviewed. Contributions made by radioisotopes in medical and research work are also discussed. (P.C.H.)

14322 CHROMIUM(VI)–1,5-DIPHENYLCARBOHYDRAZIDE REACTION AND THE EFFECT OF GAMMA RADIATION ON IT. H. E. Zittel (Oak Ridge National Lab., Tenn.). Anal. Chem., 35: 329-32(Mar. 1963).

The effect of gamma radiation on the reaction between Cr(VI) and 1,5-diphenylcarbohydrazide (DPC), commonly used for the spectrophotometric determination of Cr, was studied. The mode of reaction between Cr(VI) and DPC was clarified. An excess of Cr(VI) oxidizes the colored intermediate, and the DPC can be titrated to a colorless end point with a standard solution of Cr(VI). Extraction studies on the Cr–DPC intermediate, in which Cr^{51} was used as a tracer, proved that the Cr(III) is not intimately tied to the chromophoric group. Under the conditions used, Cr(VI) is sensitive to gamma radiation to the extent that approximately 2.5×10^{-9} mmoles per milliliter per roentgen is reduced. Both the DPC reagent and the Cr–DPC intermediate are much less sensitive to gamma radiation, being affected only about 10% as much as is Cr(VI). At levels of gamma radiation less than 1000 r, the effect of radiation introduces very little error in the method. (auth)

14323 CHEMISTRY RESEARCH BASED ON RESEARCH REACTORS. R. Hara (International Atomic Energy Agency, Vienna). At. Energy Rev., 1: No. 1, 93-140(1963).

Chemistry research with research reactors is particularly important for most centers, especially for newly developed ones, since most chemistry research is easy to start, does not require expensive auxiliary equipment or facilities and can be applied practically. A picture is given of major chemistry research carried out with research reactors, and the basic concept of the application of reactors to the field of chemistry. Although the emphasis is placed on chemistry research carried out with low and medium flux reactors, a description is given of the role of high flux reactors in chemistry research and of the future development of chemonuclear reactors. (auth)

14324 COMPLEXES OF YTTRIUM AND OF CITRIC ACID. Roger Marignan, Lucette Bardet, and Claude Brun (Laboratoire de Physique, Faculté de Pharmacie, Montpellier, France). Bull. Soc. Chim. France, No. 10, 1877-82(Oct. 1962). (In French)

The study of the complexes of yttrium and citric acid, the results of which are reported, is part of a program of investigations undertaken to obtain an yttrium radiocolloid possessing qualities required for its utilization in medicine. The processes for the formation of these complexes are defined. A distinction could be made between the compound groups, the soluble complex ions, and the salts of insoluble complex ions. A formula is proposed for some of the complexes prepared. (J.S.R.)

14325 RADIATION EFFECTS ON CELLULOSE AND PLANT ODOROUS SUBSTANCES. Hans Lueck and Friedrich Dell (Deutsche Forschungsanstalt für Lebensmittelchemie, Munich). Chimia (Switz.), 17: 1-8(Jan. 15, 1963). (In German)

The alterations of cellulose, hemicellulose, lignin, and pectin caused by ionizing radiation are discussed. Doses above 1 Mrad caused a remarkable degradation of cellulose, especially a splitting of the 1,4-β-glucosyl bond. Carbonyl and, to a smaller extent, also carboxyl groups are formed. Numerous break-down products appeared such as mono-, di-, and oligosaccharides, cellulodextrins, acids (for instance 2-ketogluconic acid and its lactone, 2-ketocellobionic acid), reductones, and gases ($CO > CO_2 > H_2$). Irradiated cellulose was more sensitive against the influence of cellulase, cellulose splitting microorganisms, and acid hydrolysis. A radiation-induced polymerization of cellulose with other substances, such as styrene, acrylonitrile, vinyl monomers, was possible. Lignin which had a certain protecting effect on cellulose was less sensitive to irradiation than cellulose. Hemicelluloses were much easier degraded than cellulose. Pectins too, especially protopectins were very sensitive to ionizing radiation when doses surpassed 0.01 Mrad. On the other hand pectin jellies made from sugar, acid, and pectin were only affected by doses above 1 Mrad. (auth)

14326 SOLID STATE POLYMERIZATION REACTIONS. S. Okamura (Kyoto Univ.). Chimia (Switz.), 17: 9-16 (Jan. 15, 1963). (In English)

In clarifying the properties of individual molecules chemistry was mainly concerned with the gaseous and the liquid phase, but now it is proceeding to the solid phase for analyzing the interactions between molecules. A special type of solid-state polymerization initiated by high energy radiation is reviewed. (auth)

14327 STUDY OF THE JOINT ACTION OF RADIATION AND OXIDE CATALYSTS ON THE DEHYDROGENATION REACTION OF CYCLOHEXANE. V. I. Vladimirova, G. M. Zhabrova, B. M. Kadenatsi, V. B. Kazanskii, and G. B. Pariiskii (Inst. of Chemical Physics, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 148: 101-4(Jan.-Feb. 1963). (In Russian)

The mechanism of radiation effects may be investigated by means of the appearance of paramagnetic centers the presence of which may be revealed electron paramagnetic resonance techniques. This method was used for clarifying the simultaneous effects of radiation and oxide-type catalysts with various electronic properties on the radiation-induced dehydrogenation reactor of cyclohexane. The catalysts tested ranged from insulators (SiO_2) through low-conductivity semiconductors (Al_2O_3, MgO, ZrO_2, and Al silicate) to the more conductive n and p type semiconductors (ZnO, NiO). The system was irradiated with 0.8-Mev accelerated electrons and by Co^{60} γ rays at a dose rate of 400 rad/sec. The SiO_2, Al_2O_3, and Al silicate catalysts exhibited the highest radiation yield; ZnO had a low and NiO no radiation activity; MgO and ZrO_2 occupied an intermediate position. (TTT)

14328 INVESTIGATION OF ORGANOTIN COMPOUNDS BY THE MÖSSBAUER γ-QUANTUM ABSORPTION METHOD. A. Yu. Aleksandrov, N. N. Delyagin, K. P. Mitrofanov, L. S. Polak, and V. S. Shpinel' (Inst. of Petrochemical Synthesis, Academy of Sciences, USSR, and Moscow State Univ.). Dokl. Akad. Nauk SSSR, 148: 126-8(Jan.-Feb. 1963). (In Russian)

Spectra of the absorption of the 28.3-kev γ-quanta by the Sn^{119} nuclei were measured by means of a method described in the Zhur. Ekspti'. i Teoret. Fiz., 43: (1962) No. 10. A source consisting of $Sn^{119m}O_2$ was used for the measurements which were carried out by cooling the absorber to the liquid N_2-temperature and involved the determination of the dependence of the resonance absorption of the γ-quanta on the velocity imparted to the absorber with respect to the source. Twenty-two organo-tin compounds were thus investigated. The values of the isomeric shifts and of the quadrupole splitting in tabular form are presented. The measurements, such as those involving compounds of the $(C_4H_9)_2Sn(C_nH_{2n+1}COO)_2$-type indicated that

the atoms next to the Sn atoms exert a strong effect on the shape of the Mössbauer spectrum. Comparison of the spectrum of $(C_4H_9)Sn(CH_3COO)_2$ with those of Cl-substituted derivatives showed that the presence of the Cl atoms, even though not directly bound to the Sn, causes a redistribution of the electron charge in the molecule. If the doublet splitting of the spectra were due only to nuclear quadrupole interaction, both doublet components should have the same height and width, but this is not the case. These differences might be due to another interaction sensitive to the magnetic quantum number at the nuclear half-level. (TTT)

14329 RADIATION-CHEMICAL OXIDATION OF POTASSIUM FERROCYANIDE IN AQUEOUS SOLUTIONS. A. V. Egunov and P. I. Dolin (Inst. of Electrochemistry, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 148: 140-3(Jan.-Feb. 1963). (In Russian)

The Bodenstein-Semenov kinetics method was used for clarifying the mechanism of the radiation-chemical oxidation of the ferrocyanide ion. There are no satisfactory literature data concerning the reaction of this ion with the radiolytic H_2O_2. Solutions containing 0.8 N H_2SO_4 and not more than 3×10^{-2} mole/liter ferrocyanide and 10^{-3} mole/liter H_2O_2 were used in the tests which involved also the determination of the reaction rate on the basis of the spectrometrically measured ferricyanide concentration. The solutions were irradiated by a Co^{60} γ-source at a dose rate of 3.66×10^{15} ev/ml sec. The mechanism was found to be a first-order reaction; its rate constant was found to be $K_0 = (2.4 \pm 0.4) \times 10^{-5}$ sec^{-1}, agreeing well with the results of B. B. Lal (J. Ind. Chem. Soc., 16: 321(1939)). The oxidation process was stoichiometric and the oxidation yield was found to increase with increasing ferrocyanide concentrations. The delayed effect, observed in the case of radiolysis of aqueous ferrocyanide solutions in the presence of atmospheric O may be due to the $H + O_2 \rightarrow HO_2$; $2HO_2 \rightarrow H_2O_2$ reactions. There were no sufficient data concerning the mechanism of the charge transfer to the OH radical by the $(Fe(CN)_6)^{4-}$ ion during the oxidation. (TTT)

14330 AN ELECTRON SPIN RESONANCE STUDY OF THE RELATIVE STABILITIES OF FREE RADICALS TRAPPED IN IRRADIATED METHANOL AT 77°K. Patricia J. Sullivan and W. S. Koski (Johns Hopkins Univ., Baltimore). J. Am. Chem. Soc., 85: 384-7(Feb. 20, 1963).

Free radicals produced by ultraviolet irradiation in a methanol matrix at 77°K exhibit half lives which range from ten minutes to a week. Observations of radical concentrations under varying conditions of temperature and isotopic substitution indicate that, while there is some decay by recombination, most of the radicals decay by hydrogen abstraction from the parent molecule that forms the matrix. The activation energy for the process was determined for several radicals. A prominent asymmetric resonance, which develops during the decay of the photolytically produced esr spectrum, was assigned to the methoxy radical. (auth)

14331 BIOSYNTHESIS OF GRAMINE: FEEDING EXPERIMENTS WITH TRYPTOPHAN-β-[H^3,C^{14}]. Daniel O'Donovan and Edward Leete (Univ. of Minnesota, Minneapolis). J. Am. Chem. Soc., 85: 461-3(Feb. 20, 1963).

A mixture of DL-tryptophan-β-C^{14} and DL-tryptophan-β-H^3 was fed to barley seedlings and resulted in the formation of radioactive gramine, which was labeled solely on the methylene group of the side chain with C^{14} and tritium. The ratio of C^{14} to tritium in the gramine was the same as in the administered tryptophans. The result strongly suggests that the methylene group of the tryptophan side chain maintains its integrity during the conversion of tryptophan to gramine. (auth)

14332 GAMMA-RADIATION-INDUCED CONDUCTANCE IN LIQUID HYDROCARBONS. G. R. Freeman (Univ. of Alberta, Edmonton). J. Chem. Phys., 38: 1022-3(Feb. 15, 1963).

The conductance of n-hexane under gamma radiation was measured as a function of voltage, and the results were plotted on a conductance vs voltage gradient graph. It is concluded that the escaped electrons behaved as massive ions. The mobility of a univalent n-hexane ion at 27°C was computed to be 1.40×10^{-3} $cm^2/v\text{-}sec$, and the yield of escaped electrons was found to be $G(esc\ e^-) \sim 0.2$. (D.L.C.)

14333 RADIOCHEMICAL POLYMERIZATION OF N-VINYL CARBAZOLE IN THE LIQUID AND SOLID PHASES. Adolphe Chapiro and Gyula Hardy (CNRS, Bellevue, France). J. Chim. Phys., 59: 993-8(Oct. 1962). (In French)

The polymerization of vinyl carbazole, exposed to gamma radiations above and below its fusion point (64°), was studied. The conversion curves all have an induction period followed by a self-accelerating portion. The lowering of the temperature produces a constant decrease of the velocity and an increase of the length of the induction period. The activation energy is approximately 12 kcal/mole for the reaction in the liquid phase and also for the initial velocity in the solid phase. The intensity exposure in the solid phase was between 0.60 and 0.75. Some experiments were also made with mixtures of vinyl carbazole and benzene. It was shown that the progressive addition of benzene to monomer produces changes analogous to those which result from an elevation of the temperature. The radiochemical polymerization of this monomer is interpretated by a radical mechanism. The addition of carbon tetrachloride to the solid vinyl carbazole causes a spontaneous polymerization, in the absence of radiation. This reaction was interpreted by allowing a priming by free radicals formed during the dissociation of a vinyl carbazole–chlorated solvent complex. (tr-auth)

14334 STUDY, BY ELECTRON PARAMAGNETIC RESONANCE, OF THE RECOMBINATION OF FREE RADICALS PRODUCED BY γ IRRADIATION OF CYCLOHEXANE AT 77°K. Henri Szwarc (Faculte des Sciences, Orsay, France). J. Chim. Phys., 59: 1067-71(Oct. 1962). (In French)

The recombination of free radicals produced by γ irradiation under vacuum of cyclohexane was studied at 77°K by electron paramagnetic resonance. It was found that in the samples crystallized by tempering in liquid nitrogen, the recombination of the radicals starts at approximately 140 to 150°K and that the experiments are irreproducible. On the contrary, in the annealed samples, the recombination commences only toward 180°K and is total in several degrees. It was concluded that the recombination is controlled only by the changes of the solid structure. It is suggested that this method can be used to study these changes in structure. (tr-auth)

14335 PAPER ELECTROPHORESIS IN THE STUDY OF THE CHEMICAL EFFECTS PRODUCED DURING β DECAY OF ^{132}Te TO ^{132}I. S. K. Shukla, M. Bacher, and J. P. Adloff (Centre de Recherches Nucléaires, Strasbourg). J. Chromatog., 10: 93-7(Jan. 1963). (In English)

The low-voltage and high-voltage paper electrophoretic behavior of iodide, iodate, periodate, tellurite, and tellurate ions was studied in sodium hydroxide and sodium chloride solutions used as electrolyte. Iodide, iodate, and periodate can be very well separated in 0.01 to 1.0 N NaOH or in sodium chloride solutions of concentration less than 0.5 N.

Simultaneous separation of iodide, iodate, periodate, tellurite, and tellurate could not be realized. One could, however, obtain the following separations: tellurate, tellurite, (iodate + periodate), and iodide in NaCl by low-voltage electrophoresis, periodate, tellurite, iodate, and iodide by high-voltage electrophoresis in sodium chloride (<0.5 N). (auth)

14336 ELECTRON SPIN RESONANCE STUDY OF RADIATION OXIDATION OF POLYMERS. IIIA. RESULTS FOR POLYETHYLENE AND SOME GENERAL REMARKS. Shun-ichi Ohnishi, Shun-ichi Sugimoto, and Isamu Nitta (Japanese Assn. for Radiation Research on Polymers, Osaka). J. Polymer Sci., Pt. A, 1: 605-23(Feb. 1963).

The effect of oxygen on ESR spectra of various kinds of irradiated polymers was examined by using a saturation technique. The radiation oxidation of some polymers was studied by means of ESR as well as infrared spectroscopy. Results for polyethylene (PE) are given with some general remarks as introduction. In PE three kinds of radicals are produced on irradiation: $-CH_2-\dot{C}H-CH_2-$ (FR_{VI}), $-\dot{C}H-CH=CH-$ (FR_{VII}), and $-\dot{C}H-(-CH=CH-)_n-CH_2-$ (FR_I). On introduction of air, FR_{VII} gave the asymmetric singlet of the peroxide radical which showed anisotropy. Reversible oxygenation of FR_{VII} took place even as low as −113°C. Radiation oxidation of PE proceeds mainly via FR_{VII}, which produced eventually about 12 carbonyl groups and about 5 hydroxyl groups in the course of post-oxidation, the trans-vinylene group decreasing by an amount nearly equal to the amount of initial FR_{VII}. FR_{VI} played only a minor role in the oxidation. An oxidation mechanism involving chain reaction is proposed. It suggests an intramolecular free-back reaction of hydrogen to the peroxide radical of FR_{VII}. FR_I (polyenyl radicals of longer conjugations) is oxidized to form carbonyl and hydroxyl groups, although it does not give the spectrum of the peroxide radical. Polyenyl radicals of shorter conjugations reacted faster. (auth)

14337 ELECTRON SPIN RESONANCE STUDY OF RADIATION OXIDATION OF POLYMERS. IIIB. POLYPROPYLENE AND POLY(VINYL CHLORIDE). Shun-ichi Ohnishi, Shun-ichi Sugimoto, and Isamu Nitta (Japanese Assn. for Radiation Research on Polymers, Osaka). J. Polymer Sci., Pt. A, 1: 625-37(Feb. 1963).

Results of ESR and infrared studies of radiation oxidation of polypropylene (PP) and poly(vinyl chloride) (PVC) are reported. The effect of oxygen on the free radicals, FR_{VIII} ($-CH_2-\dot{C}(CH_3)-CH_2-$) and FR_{IX} ($-CH_2-\dot{C}(CH_3)_2$), $FR_{I'}$ (polyenyl radicals with shorter conjugations), FR_I (polyenyl radicals with longer conjugations) in PP and $FR_{I'}$, FR_I in PVC was studied. On introduction of air, FR_{VIII} and FR_{IX} in PP and $FR_{I'}$ in PP and PVC showed the asymmetric singlet spectrum of the peroxide radical. Oxygenation of the radicals began at low temperatures: −135°C for FR_{VIII} and FR_{IX}, −144°C for $FR_{I'}$ in PP, and −170°C for $FR_{I'}$ in PVC. By reevacuation, the oxygen molecule could be removed from the peroxide radical of $FR_{I'}$ in PP and PVC, while deoxygenation was impossible from FR_{VIII} and FR_{IX}. Oxidation of the radicals in PP and PVC gave carbonyl and hydroxyl groups. The number of carbonyl groups produced per radical was estimated as 3.4 and 1.6 for $FR_{I'}$ in PP and PVC, respectively. (auth)

14338 RADIATION-INDUCED GRAFT POLYMERIZATION OF STYRENE TO NYLON. George Odian, Marjorie Sobel, Albert Rossi, Robert Klein, and Terese Acker (Radiation Applications Inc., Long Island City, N. Y.). J. Polymer Sci., Pt. A, 1: 639-54(Feb. 1963).

It was observed in the gamma radiation-induced graft polymerization of styrene to nylon that dilution of the styrene with methanol greatly accelerates the rate of styrene grafting. The compositions of the solutions absorbed by the nylon on equilibration with the various methanol–styrene solutions were determined. These results showed that the concentration of styrene available for the grafting reaction is much greater when the styrene–methanol solutions are employed than when undiluted styrene is employed. It was found that the values of k_p^2/k_t for these graft polymerizations are increased by a factor of 10^5 compared to the corresponding value in homopolymerization. These increases in the k_p^2/k_t term are ascribed to the greater viscosity of the medium in which the grafting reaction takes place and to the immobilization of the graft polymer chains by the Trommsdorff-type effect of methanol. A discussion is presented of the applicability of steady-state kinetics, as well as of the various competing reactions, in the graft polymerization. (auth)

14339 COPOLYMERIZATION OF VINYL ACETATE AND SULFUR DIOXIDE BY IONIZING RADIATION. Z. Kuri (Nagoya Univ., Japan) and Takayuki Yoshimura. J. Polymer Sci. Pt. B, 1: 107-9(Feb. 1963).

Studies were made of the copolymerization of equimolar mixtures of vinyl acetate and SO_2 by Co^{60} gamma rays. The copolymerization has a ceiling temperature of −20°C and a maximum near −60°C in the liquid state. Solid-state polymerization occurs at ~150°C. Infrared spectra of the copolymer and of pure polyvinyl acetate are compared. The copolymers were found to have 20 to 21% sulfur, indicating a 1:1 composition. (D.L.C.)

14340 CONFIGURATIONAL EFFECTS OF ACIDS IN GEL-FORMATION OF POLYVINYL ALCOHOL INDUCED BY γ-RAY IRRADIATION. Hisatake Narasaki and Shizuo Fujiwara (Tokyo Univ.). J. Polymer Sci., Pt. B, 1: 153-6(Mar. 1963).

Results are presented of an investigation in which 0.2 and 0.4% PVA solutions were irradiated in O_2-free solutions of acetic acid and a number of inorganic acids. The observed changes in appearance of the solutions are tabulated. The results show that acetic acid, HCl, HNO_3, and H_3BO_3 induced no gelation, whereas $HClO_4$, H_2SO_4, and H_3PO_4 did so in both 0.2 and 0.4% PVA solutions. $CuSO_4$, but not NaOH or KOH, also induced gelation. (D.L.C.)

14341 THE DISCOLORATION OF FATTY MATERIALS BY γ-RAY IRRADIATION — PRELIMINARY REPORT. Ikunosuke Okada, Takeaki Kihuchi, Toshiyuki Hirano, and Tadao Kitano. J. Tokyo Univ. Fisheries, 47: 289-96(Nov. 1961).

In order to explore the theory that discoloration, which is accompanied by flavor deterioration, may be caused by the action of γ rays on fats in fish products, mixtures of fats and amino acids were exposed to 5×10^5, 2×10^6, and 5×10^6 r from a 1000-C Co^{60} source. A distinct discoloration occurred when oleic acid, a prominent component of fish fats, was irradiated in the presence of certain amino acids and enhanced by subsequent incubation at 37°C. The degree of discoloration increased with the amino acid concentration and the dosage received. Several amino acids, such as histidine, methionine, and threonine, also turned yellow in the absence of fats or fatty acids whose color was greatly intensified by subsequent incubation for 48 hr at 37°C. Comparative discoloration tests made for stearic and oleic acid and fin whale and soybean oil showed various degrees of discoloration when irradiated in the presence of amino acids. It was established that for fish fats, histidine and

histamine were the agents mainly responsible for discoloration. (P.C.H.)

14342 EFFECT OF IRRADIATION ON THERMAL DECOMPOSITION OF PERMANGANATES. V. V. Boldyrev and A. N. Oblivantsev. Kinetika i Kataliz, 3: 887-93(Nov.-Dec. 1962).

Specimens of $LiMnO_4$, $KMnO_4$, $RbMnO_4$, $CsMnO_4$, and $AgMnO_4$ were irradiated with x-ray doses of 0.1 to 0.69 Mrad and their thermal decomposition studied kinetically by determining the amount of gas released as a function of time. The decomposition of $LiMnO_4 \cdot 3H_2O$ at 135°C was affected very little by irradiation, but irradiated K, Rb, Cs, and particularly Ag permanganates decomposed at 218, 240, 262, and 115°C, respectively, considerably faster than non-irradiated samples. The increase in decomposition rate was proportional to the radiation dose absorbed. The results suggest that the increased decomposition rates of irradiated permanganates are caused by the catalytic effect of the products of radiolysis rather than by ion dislocation effects. (OTS)

14343 TECHNICAL PROBLEMS OF PRODUCTION, PREPARATION AND DELIVERY OF RADIOACTIVE ISOTOPES. J. J. Arlman (N. V. Philips-Duphar, Amsterdam). Med. Mundi, 8: 18-21(1962). (In English)

Possibilities available for adequate cooling of a cyclotron target are discussed. Consideration is given to the factors that must be taken into account in the choice of a target and of the material for the target holder. Technical and chemical problems in the separation and refinement of radioisotopes are described and illustrated. Precautions, checks, and calibration tests that are necessary prior to distribution of the radioactive solutions are also discussed. (P.C.H.)

14344 SEPARATION OF RADIOIODINE FROM TELLURIUM BY MEANS OF COLUMN CHROMATOGRAPHY. N. Getoff and W. Parker (Inst. for Radiation Research and Nuclear Physics, Vienna). Nature, 197: 278(Jan. 19, 1963).

In the experiment for the separation of iodine-131 from tellurium-131 by means of column chromatography, neutron irradiated telluric acid was dissolved in 1-2 ml of distilled water and poured on top of the prepared column bed. The telluric acid solution saturates ~1/4 the absorbent material in the column. Allowing absolute alcohol to flow through the column precipitates the telluric acid in a finely distributed form while simultaneously eluting radioactive iodine. Analytical studies show the separated iodine to be free of other contaminants. This separation method is advantageous for high level activity processing since none of the components involved is likely to be effected by radiation damage. (H.G.G.)

14345 SOME PRODUCTS OF THE γ-RADIOLYSIS OF LIQUID ACETONE. J. Kučera (Nuclear Research Inst., Rez, Czechoslovakia). Nature, 197: 279-80(Jan. 19, 1963).

The main liquid products of γ irradiated acetone are acetonylacetone and isopropyl alcohol, according to chromatographic analysis corroborated by infrared spectra. (H.G.G.)

14346 PHOTOCHEMISTRY OF THYMINE. Malcolm Daniels and Alec Grimison (Univ. of Puerto Rico, Rio Piedras). Nature, 197: 484(Feb. 2, 1963).

Results are reported from studies on the photochemistry of thymine. Rapid photolysis was observed at 1849 Å. Data are presented on the nature of primary chemical reactions and photoproducts. (C.H.)

14347 DECOMPOSITION OF TRITIUM-LABELLED ORGANIC COMPOUNDS. Anthony Evans and F. G. Stanford (Radiochemical Centre, Amersham, Bucks, Eng.). Nature, 197: 551-5(Feb. 9, 1963).

Data are tabulated on the decomposition during storage of a number of tritium-labeled organic compounds at a variety of specific activities. All the compounds studied were radiochemically pure when first prepared and their subsequent rate of decomposition under various storage conditions was determined. Data are included on tritiated amino acids, nucleosides, purines and pyrimidines, steroids, and miscellaneous compounds. Results show that the decomposition of tritium-labeled compounds can be minimized by storing the compounds in a suitable solvent and below room temperatures. (C.H.)

14348 EFFECT OF IONIZING RADIATION ON ADENINE IN AERATED AND DE-AERATED AQUEOUS SOLUTIONS. J. J. Conlay (Institut du Radium, Paris). Nature, 107: 555-7(Feb. 9, 1963).

The radiation chemistry of adenine in aqueous solution was studied both in the presence and in the absence of oxygen. Solutions of adenine in triple-distilled water were irradiated at room temperature in the presence of oxygen with 40-Kv x rays and under vacuum with Co^{60} γ rays. Total doses in the range of 300,000 r were used. The resulting solutions were subjected to ion exchange chromatography. Typical elution diagrams are presented. The products were subjected to descending paper chromatography in various solvents. Data are tabulated on the degradation products identified. (C.H.)

14349 INVESTIGATION OF THE DECAY PROPERTIES OF ORGANIC SCINTILLATORS STIMULATED BY γ RAYS, PROTONS, OR α PARTICLES. K. Peuckert (Institut fur Experimentalphysik, Hamburg). Nucl. Instr. Methods, 17: 257-60(Dec. 1962). (In German)

The scintillation decay properties for the organic scintillators stilbene, NE 102, NE 150, NE 211, NE 213, NE 314, and anthracene are investigated in the time range from 3 to 200 nsec by observing the current pulses at the anode of a 56 AVP multiplier with a sampling oscilloscope of 500 Mc bandwidth. The results show that the scintillators stilbene, NE 211, and NE 213 are practically applicable for pulse shape discrimination. (auth)

14350 DIRECTIONAL ANISOTROPY IN THE CHARACTERISTICS OF THE ORGANIC-CRYSTAL SCINTILLATORS. Kineo Tsukada and Shiroh Kikuchi (Japan Atomic Energy Research Inst., Tokyo). Nucl. Instr. Methods, 17: 286-8(Dec. 1962). (In English)

The directional anisotropies in the scintillation responses of anthracene and trans-stilbene scintillators to fast neutrons are measured by changing the direction of the incident neutrons to the scintillators. For anthracene, the directions of the neutrons that correspond to the maximum and minimum scintillation yields coincide with the c'- and b-axes, respectively, where the c' axis is defined as the axis perpendicular to the ab plane. The directional anisotropy of the fast decay component is much more significant than that of the slow decay component. For trans-stilbene, no definite correlation is established between the anisotropies in the scintillation responses and the crystal structure because of the complexity of the crystal used. (auth)

14351 PHOTOPEAK EFFICIENCY AND RESPONSE FUNCTION OF VARIOUS NaI(Tl) AND CsI(Tl) CRYSTALS IN THE ENERGY RANGE UP TO 11 Mev. L. Jarczyk, H. Knoepfel, J. Lang, R. Mueller, and W. Woelfli (Technische Hochschule, Zurich). Nucl. Instr. Methods, 17: 310-20(Dec. 1962). (In English)

The photopeak efficiency for gamma rays of energy

ranging from 661 kev to 10.83 Mev, for scintillation counters with NaI(Tl) crystals of dimensions 2" × 2", 3" × 3", and 5" × 4" and a CsI(Tl) crystal of 2¾" × 2¾" was determined. The measurements were carried out with a narrow collimated and a broad parallel gamma beam, using the (n,γ) reaction as a gamma source. The effect of the energy of the gamma quanta on the shape of the response function was also measured for the same crystals and energies. (auth)

14352 CYANOPLATINATE(II) SALTS AS LUMINESCENT MATERIALS FOR SCINTILLATION COUNTING. P. Bergsoee, P. G. Hansen, and C. F. Jacobsen (Research Establishment Risø, Denmark). Nucl. Instr. Methods, 17: 325-31(Dec. 1962). (In English)

Eleven cyanoplatinate(II) salts are studied under excitation with fast, charged particles. The salts are prepared via the barium compound, and crystals are grown from aqueous solutions. The formulae are determined by standard analytical procedures. Many of the salts are colorless and the luminescence is in most cases in the blue region. The measurements include light yield and decay time under excitation with fast electrons. Most of the salts are found to be efficient scintillators. The scintillation efficiencies for α-particle excitation are smaller; in terms of the ratio α/β of relative efficiencies (light output per Mev dissipated), 0.17 is found. Possible applications of these materials are discussed, and because the abundance of high-Z material makes the salts attractive for the detection of electromagnetic radiation, some data pertinent to γ spectroscopy are given. (auth)

14353 DOSE-RESPONSE RELATIONSHIP IN THE YIELD OF RADIATION-INDUCED FREE RADICALS IN AMINO ACIDS. J. Rotblat and J. A. Simmons (St. Bartholomew's Hospital Medical Coll., London). Phys. Med. Biol., 7: 489-97(Feb. 1963).

Electron spin resonance studies were made of the production of longlived radicals in glycine, alanine, valine, aspartic acid, and glutamic acid. The yield of radicals as a function of dose was measured, using as a source of radiation 14.3-Mev electrons at a very high dose rate. In all cases saturation was observed at high doses (in the megarad range). The yield vs dose curves were analyzed in terms of exponential functions and some possible explanations put forward. Absolute values of the yield per unit dose, as well as the saturation values, were calculated, and possible sources of error in the values are discussed. (P.C.H.)

14354 ADSORPTION OF RADIO-ISOTOPES ON POLYMER ADSORBENTS. III. ADSORPTION OF Cs, Tl, Ag, AND Sr ON FLUOROPLASTIC-4 AND POLYETHYLENE. I. E. Starik, V. N. Shchebetkovskii, and I. A. Skul'skii. Radiokhimiya, 4: 393-8(1962). (In Russian)

Studies of fluoroplastic-4 electrokinetic potential dependence on pH in weakly acid and weakly alkaline solutions indicated a negative charge on the surface and linear ζ potential changes in the pH region 3 to 10. At constant pH and ionic strength the fluoroplastic-4 ζ potential depends on cation properties, following the order $Li^+ > Na^+ > K^+ > Cs^+ > Tl^+ > Ag^+$. At constant pH and variable ζ potential the absorption of Cs, Tl, and Ag ions by photoplastic-4 and polyethylene increases, $Cs^+ < Tl^+ < Ag^+$. (R.V.J.)

14355 EFFECTS OF HALIDE COMPOUNDS ON THE TRITIUM–BENZENE ATOMIC RECOIL. V. V. Pozdeev, A. N. Nesmeyanov, and B. G. Dzantiev. Radiokhimiya, 4: 398-404(1962). (In Russian)

Effects of halide compounds on the yield of labeled products were studied using solid phases of benzene–iodine, benzene–methyl iodide, benzene–bromine, and cyclohexane–iodine and $Li^6(n,\alpha)T$ reactions as the tritium recoil source. It was found that the yield of labeled benzene increases 1.5 fold in the presence of iodine. It was postulated that an intermediate complex forms between tritium atoms and benzene molecules. It is also shown that the scattering energy increases resulting in larger labeled benzene yield. Paramagnetic complexes were observed in dilute benzene solutions. (R.V.J.)

14356 EFFECTS OF AGGREGATE STATE ON TRITIUM RECOIL REACTION WITH HYDROCARBON. V. V. Pozdeev, A. N. Nesmeyanov, and B. G. Dzantiev. Radiokhimiya, 4: 404-10(1962). (In Russian)

Reactions of tritium recoils in liquid and solid cyclohexane, cyclohexene, cyclohexadien-1.4, and benzene were studied using a $Li^6(n,\alpha)T$ source. It was found that the yield of labeled hydrocarbons (limited, unlimited, and aromatic) increased in transition from liquid to solid states. It is postulated that excited molecules form between the mother molecule and an atomic recoil. (R.V.J.)

14357 SEPARATION OF RARE EARTH RADIOISOTOPES ON Hg CATHODE. I. SEPARATION OF Y, YB, AND Lu. V. P. Shvedov and I-bei Fu. Radiokhimiya, 4: 451-61(1962). (In Russian)

Electrolytic separation of yttrium, ytterbium, and lutetium or erbium is described, and the scheme for complete separation of Y^{91}, Yb^{169}, and Lu^{177} is given. (R.V.J.)

14358 SEPARATION OF RARE EARTH ON Hg CATHODE. II. SEPARATION OF Ce AND Pm FROM Lu AND Eu FROM Ce AND La. V. P. Shvedov and I-bei Fu. Radiokhimiya, 4: 457-61(1962). (In Russian)

A complete separation of Pm^{147} and Lu^{177}, and Ce^{144} and Lu^{177} was achieved, and the possibility of separating cerium from the yttrium group, except for yttrium and ytterbium, is explored. Descriptions are given of a mercury cathode separation of La^{140} and Ce^{144} from Eu^{152} and Eu^{154}. (R.V.J.)

14359 CHEMICAL EFFECTS OF Br^{82} RECOIL ATOMS PRODUCED IN (n,γ) REACTION IN HALOID ACETIC ACID. A. N. Nesmeyanov, E. S. Filatov, and I. G. Gusakovskaya. Radiokhimiya, 4: 462-9(1962). (In Russian)

Chemical processes induced in bromo- and chloroacetates and acetic acid by solid-state $Br^{81}(n,\gamma)Br^{82}$ reactions (and for liquid-phase acetic acid) are investigated. Analyses of products containing Br^{82} recoil atoms reveal several compounds with variable yields depending on halogen properties, α-position in relation to COOH group, and the phase during irradiation. It is shown that the yield of CH_3Br^{82} depends on the separation method. The yields of other products do not depend on the separation method. The possible mechanism of the secondary chemical reactions of recoil atoms in Be^{82}-bromoacetate and chloroacetate reaction is discussed. (R.V.J.)

14360 MEASUREMENTS OF β SOURCES BY CHEMICAL DOSIMETRY. G. A. Mikhalchenko and I. Kleinmann. Radiokhimiya, 4: 479-86(1962). (In Russian)

Energy variations from $Sr^{90} + Y^{90}$ β sources of tens to hundreds of mC were studied, and the relation between absorbed energy and specimen thickness was estimated. The developed dosimetry was used in β source calibration. (R.V.J.)

14361 ON THE SEPARATION OF Zn NUCLEAR ISOMERS. V. D. Nefedov, E. N. Sinotova, and Shu-chen Sun. Radiokhimiya, 4: 497-8(1962). (In Russian)

The separation of isomeric Zn^{69m} (T = 14h) → Zn^{69}(T = 51 min), prepared by reactor neutron bombardment of me-

tallic zinc, was based on γ recoil and symmetrization in $R'R''Zn$ derivatives. The recoil energy of Zn^{69} in γ emission (~1.5 ev, ~35 kcal/mole) is sufficient for two molecule symmetrization in the $R'R''Zn + R'R''Zn = R'_2Zn + R''_2Zn$ scheme, where one radical is heavier than the other. Thus, half the Zn^{69} atoms appear in a volatile compound, $Zn(C_2H_5)_2$, and the other half in nonvolatile $Zn(C_4H_9)_2$, allowing separation by chromatography. (R.V.J.)

14362 SORPTION OF RADIOACTIVE COBALT BY PEAT. V. F. Oreshnikov, A. I. Berdnikov, and V. V. Przhbyl'skaya. Radiokhimiya, 4: 499-502(1962). (In Russian)

Kinetics of radioactive cobalt adsorption from low activity solutions by various peats was studied. It was found that hypnal and sedge hypnal peat have higher adsorption ability. The rate and limit of adsorption from low activity solutions do not depend on the degree of granulation. Both types of peat can be utilized for the purification and filtration of radioactive sewer water. The total adsorption and adsorption rate drop with peat decomposition. (R.V.J.)

14363 EXCHANGE BETWEEN RADIOACTIVE AND STABLE NIOBIUM IN CITRIC ACID COMPLEXES BY MEANS OF ISOTOPIC DILUTION. I. P. Alimarin, G. N. Bilimovich, and Yu-cen Yang. Radiokhimiya, 4: 510-14 (1962). (In Russian)

Extraction of radioactive and stable niobium 8-oxychinoline complexes from citric acid by chloroform exhibits a dependence on Nb concentration due to its polymerization. The exchange between radioactive and stable Nb in citric acid was analyzed, and a complete exchange was determined by means of isotopic dilution. It is suggested that combined dissolution of an active tracer and available inactive solutions produced better analytical results. (R.V.J.)

14364 BEHAVIOR OF Sb IN ANION EXCHANGE. EFFECTS OF SZILARD-CHALMERS ON ION-EXCHANGE COLUMN. L. I. Moskvin. Radiokhimiya, 4: 514-16(1962). (In Russian)

A separation of Sb^{118m} from other antimony isotopes was achieved by means of Szilard-Chalmers effect. In hydrochloric solution of >2n Sb(III), tracer amounts of Sb are retained by resins. A solution of 0.2M NH_4OH + 0.2M NH_4CH_3COO is used for elution. (R.V.J.)

14365 THE ADSORPTION OF TETRAVALENT PLUTONIUM ON GLASS AND QUARTZ. A. G. Samartseva. Radiokhimiya, 4: 647-55(1962). (In Russian)

Pu^{239} nitrate solutions were used for studying the adsorption of $Pu^{(IV)}$ on glass and vitreous silica; the concentration of the solutions was varied from 1×10^{-8} to 5×10^{-10}M while using silica discs and small glass beakers as adsorbents. A period of 5 to 8 hours was needed to reach the adsorptive equilibrium of the Pu at various pH values; the distribution of the Pu between the solution and the surface of the adsorbent was determined by measuring the α-activity with a 4π counter. The adsorption coefficient was expressed as the ratio of the activities 1 cm^2/1 cm^3 solution × 100. It was found that the adsorption on both surfaces tested increases with increasing H ion concentration. Silica exhibited a considerably higher adsorptive capacity than glass. A decrease of the $Pu^{(IV)}$ concentration resulted in a shift of the absorption maximum toward higher pH values, from pH = 2.8 to 3.6; this was due to the formation of a colloidal Pu because the solubility product of Pu hydroxide was reached. Desorption studies indicated that in the case of solutions with pH < 4, the adsorption process on glass is reversible; this is true to a much lesser extent at pH > 4. The presence of sharp maxima in the curves pointed toward the existence of true Pu colloids at pH ≃ 3. (TTT)

14366 INVESTIGATION OF THE COMPLEX FORMATION OF THORIUM WITH CERTAIN OXYDICARBOXYLIC ACIDS. A. V. Lapitskiĭ, Geletseanu, and M. Beran. Radiokhimiya, 4: 672-7(1962). (In Russian)

The ion exchange method was used for comparing the complex formation of Th with malic, trioxyglutaric, and tartaric acids with similar data obtained by O. E. Zvyagintsev and L. G. Khromenkov (Zhur. Neorg. Khim., 6: 874(1961) No. 4.) by means of electrical conductivity measurements. The β-active $Th^{234}(UX_1)$, prepared by extraction from uranyl nitrate solution with diethyl ester, together with the Na salt of Dowex 50 × 5400 and cp oxydicarboxylic acids were used for the study, which involved the determination of the adsorption of the Th by cationite as a function of the concentration of additives to the solution under equilibrium conditions. It was found that in hydrochloric solutions the sorption reaches a maximum at pH = 2 while the charge was close to 4. The Th was present in the form of nonhydrolyzed Th^{4+} ions. The Th formed complexes with the 3 acids when the Th : acid ratio was kept at 1 : 1. The instability constant of the complexes was found to be about 10^{-6} $mole^2$ $liter^{-2}$. The average charge of the malic complex was found to be close to 10, indicating that multinucleic complex cations, including possibly $/Th(HAp)/_n^{3n+}$ and $/Th(HAp)_2/_n^{2n+}$, are formed in the system. Malic acid is the only one to form complexes with a Th : acid ratio of 1 : 2; the instability constant of these complexes is about 10^{-7} $mole^2$ $liter^{-2}$. (TTT)

14367 THE COEFFICIENT OF LINEAR EXPANSION OF IRRADIATED ALKALI HALIDE CRYSTALS. I. N. Anokhina, I. G. Berzina, and P. A. Savintsev (Tomsk Polytechnic Inst., USSR). Soviet Phys.-Cryst. (English Transl.), 7: 514-15(Jan.-Feb. 1963).

Radiation effects on the coefficients of linear expansion of NaCl, KCl, and KBr are discussed. Changes in the coefficients of linear expansion of the crystals irradiated at room temperature were studied over the temperature range 100 to 500°C. It was found that the coefficients of linear expansion increased when measured immediately after irradiation, and the increase was more noticeable at the higher temperatures. The coefficient of linear expansion of the irradiated crystals decreased with increasing duration of annealing, and after 8 hr equaled the initial value corresponding to a nonirradiated crystal. On further annealing the coefficient continued to decrease and reached a constant value after 28 hr. It was concluded that the decrease in the coefficient of linear expansion with time after irradiation can be explained by a change in the density of defects, and in particular a change in the density of dislocations. (P.C.H.)

14368 THERMOMECHANICAL STUDY OF EFFECT OF ORGANOTIN STABILIZERS ON PVC EXPOSED TO HEAT AND γ-IRRADIATION. M. N. Shteding and V. L. Karpov. Vysokomolekul. Soyedin., 4: 1806-10(Dec. 1962).

The effect of six organo-tin stabilizers on polyvinyl chloride (PVC) subjected to 160°C or to γ-irradiation was studied. Tablets or 0.25-mm films of dibutyl phthalate-plasticized II Φ-4 type PVC or such PVC containing added dibutyl-tin maleate (I) (from two sources), dichloride (II), dilaurate (III), disalicylate (IV), or dimyristate (V) were exposed in air to 160°C for 2 to 8 hrs or to γ radiation from a Co^{60} source with 10 to 25-mrad doses. Thermomechanical curves were recorded to determine the nature of changes in PVC structure and crosslinking rate, as well

as the effect on these properties of compounds I to V. The high-temperature experiments showed that these compounds inhibit crosslinking and oxidative degradation in PVC exposed to 160°C; I and II were the best stabilizers (no crosslinking after 8 hrs), V was the poorest, and III and IV were intermediate in effectiveness. The stabilizing effect appeared to decrease with the dibutyl-tin content of the stabilizer. Tests with γ-irradiation indicated that compounds I to V have practically no inhibiting effect on γ-induced crosslinking. However, they all prevented yellowing and browning of PVC films exposed to 160°C or γ rays, indicating that these compounds are oxidation inhibitors and HCl acceptors. They also improved the low-temperature resistance (brittle point) of nonirradiated films. Compounds II and V lowered the tensile strength and elongation of PVC films, whether γ-irradiated or not. (OTS)

14369 X-RAY PHOTOCURRENT, UV PHOTOCURRENT, AND FLUORESCENCE IN ANTHRACENE. Heinz Kurt Hartmann (Universität, Giessen, Ger.). Z. Angew Phys., 14: 727-34(Dec. 1962). (In German)

The photocurrent induced in anthracene crystals by x or uv irradiation is distinguished according to its voltage dependence, activation energy, intensity dependence, and dose dependence. Decrease of the x and uv photocurrent as a result of preliminary x irradiation was explained by the production of recombination centers. The photocurrent is more sensitive to radiation damage than the fluorescence. (tr-auth)

14370 THE ALTERATION OF THE LUMINESCENT YIELD AND THE ELECTRICAL CONDUCTIVITY OF ZnO BY ADSORPTION OF OXYGEN. Bernd Hoffman and Erich Mollwo (Universität, Erlangen, Ger.). Z. Angew Phys., 14: 734-8(Dec. 1962). (In German)

By heating ZnO vapor-deposited films in vacuum to over 400°K and then cooling to room temperature, it is possible to alter its conductivity by more than an order of magnitude. The luminescent yield is not altered. Dry oxygen, attacking the annealed layer at 300°K, reduces the conductivity by about 90% and the luminescent yield by 10%. These results can be explained by the following two assumptions: the oxygen was adsorbed on the surface of the ZnO and can bind conduction electrons from the entire film volume, so that the conductivity value decreases. Moreover, the oxygen can fill the oxygen gaps present in the external crystal lattice plane of the ZnO so that activators for the green luminescence are lost. (tr-auth)

14371 RADIATION CHEMICAL MODIFICATIONS OF THYMINE AND CYTOSINE IN DNA BY UV LIGHT. Hanswerner Dellweg and Adolf Wacker (Universität, Frankfurt am Main). Z. Naturforsch., 17b: 827-34(Dec. 1962). (In German)

The effect of uv radiation (254 mμ) on bacteria and DNA leads to the formation of a series of photoproducts. Thymine forms a thymine dimer and at least two additional photoproducts. From cytosine, uracil is formed and also at least two additional photoproducts. The thymine dimer can be changed back to thymine with yields of 87% by irradiation with uv in aqueous solution. This reaction is not successful in the usual photoproducts. The biological damage caused by uv irradiation in the bacteria cells must be traced back extensively to the formation of dimer thymine. On the other hand, the usual photoproducts, which first occur at higher uv doses, are only of secondary biological significance. The formation of thymine photoproducts in the cells of E. coli, which is dependent on the radiation dose, was quantitatively investigated. Denaturation of the native DNA by heating or by splitting off of the purine to apurinic acid has the result that the formation of the thymine dimer and one of the usual thymine photoproducts was especially strongly favored. (tr-auth)

Raw Materials and Feed Materials

14372 (JEN-110-SIG-12) ESTUDIO MINERALOGICO DEL MATERIAL BENEFICIABLE PROCEDENTE DE LA "MINA FE", CIUDAD RODRIGO. (SALAMANCA). (Mineralogical Study of Workable Material Coming from "Mina Fe", Ciudad Rodrigo, Salamanca). E. Mingarro Martin (Spain. Junta de Energia Nuclear, Madrid). 1962. 48p.

A mineralogical analysis is made to ascertain the effects of acid leaching under normal conditions. U is mainly found in the uranotile, pitchblende, and autunite form with an average assay of 0.4%. The loss of U in tailings under current processing conditions is mainly the result of pitchblende being practically non-leachable, and to U absorption by hydrated Fe oxides and colloidal ores. (auth)

14373 (PAN-361/IV) QUELQUES NOTIONS SUR L'EXTRACTION GAZEUSE DE L'URANIUM DE SES MATIERES PREMIERES NON-PREPAREES. (Some Remarks on Gaseous Extraction of Uranium from Raw Materials). Tadeusz Adamski and Jarosław Zienkiewicz (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Sept. 1962. 12p.

By treating raw uranium materials at 800°C with a mixture of chlorine and carbon dioxide, a large part of the uranium can be extracted. The yield, under favorable conditions, can attain more than 85%. (tr-auth)

14374 PURIFICATION OF URANIUM HEXAFLUORIDE. Claude Fabre and Jean-Claude Martin (to Commissariat à l'Énergie Atomique). Canadian Patent 652,609. Nov. 20, 1962. Priority date Aug. 14, 1959, France.

An apparatus and process continuous purification of UF_6 involving crystallization and sublimation of the UF_6 in a unique subliming cyclone provides most of its own operational power. (D.C.W.)

Separation Processes

14375 (BM-RI-6205) CHELATING AGENTS IN SEPARATION OF RARE-EARTH COMPOUNDS BY SOLVENT EXTRACTION WITH AMINES. Andrew Carl Rice (Bureau of Mines. Reno Metallurgy Research Center, Nev.). Sept. 1962. 18p.

Aminopolyacetic acid chelating agents were added to separatory-funnel-scale solvent-extraction systems to determine the effect on separating rare-earth elements. Average values for separation factors between adjacent elements obtained with Primene JM-T[2] increase 36% when EDTA is added to the aqueous phase. Adding HEDTA or DCTA also improves separation factors for certain rare-earth elements. Percentage of extraction and the separation factors exhibit marked sensitivity to concentrations of amine, chelating agent, and hydrogen ion. The chelating agents improved separation ni Primene JM-T, BHDA, and Primene 81-R extraction systems. (auth)

14376 (LADC-5634) THE ELECTROCHEMICAL SEPARATION BEHAVIOR OF PROMETHIUM AT A LITHIUM AMALGAM CATHODE. E. I. Onstott (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract [W-7405-eng-36]. 7p.

Pm behaves like a typical (III) lanthanon and falls between Nd and Gd in the electrochemical separation scheme. Separation factors between 1.3 and 3.7 were measured for

the Nd/Pm pair. The separation factor for this pair increased with increasing electrolyte concentration of lanthanons and/or increasing concentration of excess lithium citrate. Separation factors between 2.0 and 18.0 were measured for the Pm/Tb pair. The separation factor for this pair increased with increasing electrolyte concentration of lanthanons at constant concentration of excess lithium citrate, but decreased with increasing concentration of excess lithium citrate with the total concentration of lanthanons held constant. There appears to be a difference in behavior between Gd and Tb with Gd behaving more like the lighter lanthanons. (auth)

14377 (NSEC(T)-15) THE RECOVERY OF VOLATILE FISSION PRODUCTS FROM MOLTEN URANIUM–BISMUTH. I. J. Gruverman and R. C. Koch (Nuclear Science and Engineering Corp., Pittsburgh). May 25, 1960. Contract [AT-(30-1)-2588]. 32p.

Irradiation capsule tests were performed with uranium-bismuth alloys to study the effects of temperature, helium sweep rate, and cyclic U–Bi phase changes on the rate of removal of volatile fission products, to develop a rapid method of quantitative separation of these fission products from the U–Bi alloy, and to study the fate of the less volatile fission products which might be transported across the liquid-gas interface. Post-irradiation experiments demonstrated that increasing temperature enhances the removal of xenon from molten U–Bi alloy to a greater extent than other parameters. A virtually quantitative separation of xenon was achieved by sweeping the U–Bi alloy, at a temperature of 1050°F, with helium for about 30 minutes. The steady-state release rate of iodine at this temperature was shown to be less than 1% of that for xenon. Radioactivity balance studies showed that the iodine and other less volatile fission products which may be transported to the helium phase are deposited rapidly on the containing surfaces. (auth)

14378 (ORNL-TM-395) CONTINUOUS DISSOLUTION OF ZIRCONIUM REACTOR FUELS IN TITANIUM EQUIPMENT: LABORATORY DEMONSTRATION. T. A. Gens (Oak Ridge National Lab., Tenn.). Jan. 23, 1963. Contract [W-7405-eng-26]. 16p.

Continuous dissolution of 2% U–Zr alloy fuel in a laboratory-scale Ti dissolver was demonstrated using refluxing 3 M HNO_3–1.2 M HF–0.4 M HBF_4–0.6 M Cr(III)–0.4 M Cr(VI)–0.46 M Zr as the dissolvent. Dissolution rates and solution corrosion rates were 8 to 16 mg/cm^2-min and ~1 mil/month, respectively. Reagent was added to the dissolver at the rate needed to maintain the potential measured by a Au vs. calomel electrode in the product effluent as close to a preselected standard value as possible. (auth)

14379 (AEC-tr-5652) TREATMENT OF FUEL ELEMENTS BY THE DRY METHOD. IV. URANIUM–MOLYBDENUM ALLOYS. M. Bourgeois and G. Manevy (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). Translated for Oak Ridge National Lab., Tenn. from Test Report No. 297. Nov. 1962. 40p.

Processing of irradiated Mo–U fuel by conversion to oxygenated or fluorinated intermediates and final conversion of the U to UF_6 were investigated. The reactions with HCl–O_2 mixtures leave the U in the form of a non-volatile residue composed mainly of U_3O_8, while a large part of the Mo is volatilized. The reactions with HF–O_2 mixtures leave the U as a non-volatile residue. The Mo in this reaction is entirely volatilized. This method offers the possibility of saving F_2. (J.R.D.)

14380 A SIMPLE METHOD FOR SEPARATING POLAR STEROIDS FROM THE LIQUID SCINTILLATION PHOSPHOR. Richard S. Rivlin and Hildegard Wilson (National Cancer Inst., Bethesda, Md.). Anal. Biochem., 5: 267-9(Mar. 1963).

A method is described for the separation of phosphor in the 5 to 10 ml toluene from testosterone and more polar steroids by means of thin-layer chromatography. Relatively large amounts of phosphor (20 mg PPO in 5 ml solution) can be separated from much smaller amounts of corticoid by the method. The use of thin-layer chromatography has enabled radioactive materials to be reutilized and purified further, once the initial measurements have been obtained. (P.C.H.)

14381 SOLVENT EXTRACTION OF CERTAIN TRANSITION METAL IONS WITH 1-(2-PYRIDYLAZO)-2-NAPHTHOL. A STUDY OF COMPLEX FORMATION AND DISTRIBUTION EQUILIBRIA. D. Betteridge, Quintus Fernando, and Henry Freiser (Univ. of Arizona, Tucson). Anal. Chem., 35: 294-8(Mar. 1963).

A study was made of the extraction of the complexes of Mn(II), Zn(II), Cu(II), Ni(II), and Co(II) with 1-(2-pyridylazo)-2-naphthol (PAN) from water into CCl_4 or $CHCl_3$. Mn(II) and Zn(II) form extractable complexes containing a 1 to 2 metal-ligand ratio. The overall formation constant of the $Zn(PAN)_2$ complex was found to be $10^{21.5}$. At pH above 8.5, Zn(II) formed a different extractable complex, whose composition was not determined. The formation of an extractable Cu(PAN)(OH) complex was postulated. The formation constant of the $Cu(PAN)^+$ complex was found to be $10^{12.6}$; the hydrolysis constant, $10^{-6.9}$. The cobalt and nickel complexes of PAN showed anomalous behavior. (auth)

14382 STERIC EFFECTS IN THE SYNERGIC EXTRACTION OF THE LANTHANIDES, YTTRIUM, AND SCANDIUM. P. G. Manning (Dept. of Mines and Technical Surveys, Ottawa). Can. J. Chem., 41: 658-66(Mar. 1963).

From a study of the partitioning of the carrier-free radioisotopes Tm^{170}, Ce^{144}, $Eu^{152/154}$, Tb^{160}, Lu^{177}, and Y^{91} between nitric acid and organic solutions containing various proportions of thenoyltrifluoroacetone (HTTA) and dialkyl alkyl phosphonates (S) in odorless kerosene, concentration equilibrium constants (k_2) were computed for the reaction $M^{3+}_w + 3HTTA_o + 2S_o = M(TTA)_3S_{2o} + 3H^+_w$, where M represents a metal ion, and "w" and "o" are aqueous and organic species respectively. When used in conjunction with the data of Bronaugh and Suttle, the equilibrium constants determined in this study yielded comparative equilibrium constants (k_3) for the solvation process $M(TTA)_{3o} + 2S_o = M(TTA)_3S_{2o}$ for the rare-earth metals listed. In the extraction of Sc^{46}, however, the species extracted is dependent on the alkyl groups of the phosphonates, the butyl and 2-ethylhexyl derivatives giving mono- and di-solvates respectively. It is concluded that steric effects are dominant in these synergic systems. (auth)

14383 METHOD FOR REMOVING IODINE^{131} FROM MILK. G. K. Murthy (Robert A. Taft Sanitary Engineering Center, Cincinnati), J. E. Gilchrist, and J. E. Campbell. J. Dairy Sci., 45: 1066-74(Sept. 1962).

Fresh samples of raw whole milk containing I^{131} (either added and stored for 24 hr at 4°C before use, in vivo labeled, or market milk samples contaminated with fresh fallout) were passed through a column (2.0 × 4.8 cm) containing 15 ml of Dowex 2-X8 anionic resin previously charged with an aqueous solution containing NaCl, NaH_2PO_4, and $Na_3C_6H_5O_7$ at pH 6.6. Analysis of the treated milk indicated that approximately 98 ± 2% of I^{131} was removed from

120 to 130 resin bed volumes of milk (and about 95% from 230 resin bed volumes). The removal of I^{131} did not vary with flow rates of 5 to 20 ml per min, and the anionic composition was essentially unchanged. Also, the rate of removal was not affected by temperature. All the I^{131} in milk was removed except the protein-bound I^{131}, which was not available for ion exchange. The flavor of resin-treated milk was comparable to that of untreated milk. The absorbed I^{131} on the resin may be stripped with 2N HCl prior to resin regeneration. (P.C.H.)

14384 SEPARATION OF ZIRCONIUM AND HAFNIUM BY REVERSED PHASE PARTITION CHROMATOGRAPHY. R. H. A. Crawley (English Electric Co., Whetstone, Leicester, Eng.). Nature, 197: 377-8(Jan. 26, 1963).

An investigation was made of reversed phase partition chromatography for the separation of Zr and Hf. Data are tabulated showing the eluants investigated and the amounts of Hf and Zr in the different fractions. (C.H.)

14385 INTERSOLUBILITY IN URANYL NITRATE–WATER–ISOPROPYL ETHER. V. M. Vdovenko, I. G. Suglobova, and M. Mezei. Radiokhimiya, 4: 388-92(1962). (In Russian)

Uranyl nitrate–water–isopropyl ether and uranyl nitrate–water–n–propyl ether solubilities were measured at 25°C. Three solid phases were separated in the system with isopropyl ether: $UO_2(NO_3)_2 \cdot 3H_2O \cdot 3(C_3H_7)_2O$, $UO_2(NO_3)_2 \cdot 2H_2O \cdot 4(C_3H_7)_2O$, and $UO_2(NO_3)_2 \cdot 2(C_3H_7)_2O$. With n-propyl ether, the systems $UO_2(NO_3)_2 \cdot 6H_2O$, $UO_2(NO_3)_2 \cdot 3H_2O \cdot (C_3H_7)_2O$, $UO_2(NO_3)_2 \cdot 2H_2O \cdot 2(C_3H_7)O$, and $UO_2(NO_3)_2 \cdot 2(C_3H_7)_2O$ were formed. The solubility of uranyl nitrate in isopropyl ether is lower than in normal ether. The low solubility is the result of weak interactions between the solvent and the surrounding layer of ether molecules and the absence of polymeric forms. (R.V.J.)

14386 THE EXTRACTION MECHANISM OF HEXAVALENT URANIUM BY MEANS OF TRIDECYL AMINE FLUORIDE. V. M. Vdovenko, A. A. Lipovskiĭ, and S. A. Nikitina. Radiokhimiya, 4: 625-32(1962). (In Russian)

The problems involved in the extraction of hexavalent U by means of amine salts from solutions in which it forms relatively stable salts, were studied by treating uranyl salt solutions containing HF + NaF with tridecyl amine (TDA) fluoride, using benzene as diluent. The work involved the spectrographic determination of fluoride complexes formed by uranyl compounds in the organic phase, making use of tributyl phosphate as reference solvent. The formation of $TDAHUO_2F_3$ and $(TDAH)_2UO_2F_4$ was established. Under the experimental conditions used no compounds were found to exist when the F/U ratio was >4. The mechanism of the extraction of UO_2F_2 from aqueous solutions by TDA fluoride was found to involve the formation of complexes including 1 or 2 TDA–HF molecules. Best results were obtained when there was no excess of F^- in the solution. (TTT)

14387 THE ISOPIESTIC METHOD FOR DETERMINING THE SOLVATION NUMBER IN CASE OF EXTRACTION. E. V. Komarov. Radiokhimiya, 4: 633-8(1962). (In Russian)

An attempt was made to estimate the approximate limits of the applicability and the precision of the isopiestic method for investigation of extraction processes. Nonvolatile extracting agents and volatile solvents, such as CCl_4 and C_6H_6 were used for the study. The solvation number of various uranyl salts and of La nitrate were determined, the degree of polymerization of dibutyl phosphoric acid in CCl_4 was measured, and the materials under study were compared with a known reference solution. The results obtained by the isopiestic method were found to diverge by about 6%, reaching a maximum value of 15% in one case. The results indicated that at least for the cases examined, the simplified method and the solvents chosen were satisfactory. The precision obtained by the isopiestic method in the determination of the solvation number is comparable to that of the cryoscopic method. The problems encountered in both cases are due to lack of knowledge of the value of the needed thermodynamic functions of the solutions. (TTT)

14388 STUDY OF THE COMPLEX FORMATION OF AMERICIUM WITH DI-ISOAMYL ESTER METHYLPHOSPHINIC ACID (DAMP). V. I. Zemlyanukhin, G. P. Savoskina, and M. F. Pushlenkov. Radiokhimiya, 4: 655-60 (1962). (In Russian)

In view of the good results obtained with DAMP (di-isoamyl ester methylphosphinic acid) in the extraction of Pu, the complex formation of trivalent Am and its extraction from nitric, perchloric, hydrochloric, sulfuric, and acetic acid solutions with this agent were investigated. The tests were carried out at 20 ± 2°C, mixing the organic and aqueous solutions for 5 minutes, then centrifuging and analyzing the mixture. The Am^{241} preparation used contained less than 2% of other α emitters; its concentration was determined radiometrically, while the concentration of the acids was obtained by titration. The results indicated that DAMP has the same properties as tributyl phosphate. The distribution coefficient of Am was found to be quite high during the extraction from nitric and perchloric acid solutions in which it forms a trisolvate; on the other hand the element does not lend itself well for extraction from solutions containing any of the 3 other acids. The constant of complex formation of the compound $Am(NO_3)_3 \cdot 3$ DAMP was found to be k = 8.3. (TTT)

14389 INVESTIGATION OF THE PROCESSES AND OF THE PRODUCTS OF THE INTERACTION OF HIGH-MOLECULAR COMPOUNDS WITH INORGANIC SALTS. I. FORMATION OF POLYACROLEIN COMPLEXES WITH URANYL NITRATE. I. V. Andreeva, P. F. Andreev, and E. M. Rogozina. Radiokhimiya, 4: 660-7(1962). (In Russian)

Modification of polymers, such as polyacrolein, which possess complexing groups makes it possible to prepare compounds able to react selectively with inorganic salts. Experiments carried out under static conditions on the formation of coordination complexes with uranyl nitrate showed that the amount of U extracted with pH values ranging from 3 to 4 varies greatly: the amount of U extracted per 1 g of the polymer was found to be a function of the aldehyde groups. Best results were obtained with samples prepared by the oxidation–reduction polymerization in the presence of K persulfate with $AgNO_3$ and Mohr's salt. Polyacrolein prepared by low-temperature polymerization with BF_3 had the lowest ability to extract U. The complex formation took place at pH values from 3 to 4; its rate was greatly reduced beyond these limits. The distribution coefficient of U for the organic and aqueous phases varied between 0.005025 and 0.04703. The compounds used were highly specific toward U and did not extract Co, Ni, Mn, and Pb. The extracted $UO_2(NO_3)_2$ may be conveniently redissolved by treatment with a weak HCl solution. (TTT)

14390 STUDY OF THE COMPLEX FORMATION BETWEEN THE URANYL ION AND ORTHO-PHOSPHORIC ACID. V. I. Karpov. Radiokhimiya, 4: 667-71(1962). (In Russian)

Spectrophotometric and sorption methods were used for

investigating the complex formation of the uranyl ion with orthophosphoric acid in the low concentration range of the latter. The complex formation was detected by an increase of the optical density of the solution and a shift of the absorption threshold. A portion of the ternary phase diagram was studied, keeping the concentration of the added constant. The existence of the following phases was established: $[UO_2PO_4]^-$; $[UO_2H_2PO_4]^+$; $[UO_2H_3PO_4]^{2+}$; it is considered quite probable that the $[UO_2HPO_4]^0$ also exists. These compounds are in equilibrium with each other when the U : P ratio is kept at 1 : 1. This conclusion was indirectly confirmed by the precipitation of solid salts. Thus, the binary salts $NH_4UO_2PO_4 \cdot 3H_2O$, $NaUO_2PO_4 \cdot 3H_2O$, etc. correspond to $[UO_2PO_4]^-$ and so on. (TTT)

14391 SOME DATA ON THE BEHAVIOR OF TETRAVALENT URANIUM IN NITRIC ACID SOLUTIONS. N. P. Ermolaev and N. N. Krot. Radiokhimiya, 4: 678-85(1962). (In Russian)

In order to clarify the separation processes of U by the extraction and ion exchange methods the formation of complexes of $U^{(IV)}$ with the NO_3^- ion was investigated spectrophotographically and by ion exchange. The studies were carried out with a Beckmann quartz spectrophotometer using $U^{(IV)}$ perchlorate, prepared by the electrolytic reduction of uranyl perchlorate. Increase of the HNO_3 concentration up to 10M resulted in a continuous change of the absorption spectrum as a result of complex formation. The largest difference between the molar extinction coefficients of $U^{(IV)}$ and its nitrate complexes was noted at $\lambda = 648$ mμ. The coloration of the solution followed the Lambert-Beer law if the NO_3^- concentration and the ionic strength were kept constant. The oxidation reaction was autocatalytic, being accelerated by the decomposition products of the nitrate ions. The reaction rate was controlled by the $U^{4+} + NO_2^+ + H_2O \rightarrow UO_2^+ + NO + 2H^+$ reaction. Aromatic amino derivatives, such as anthranylic and sulfanylic acids acted as stabilizers of the $U^{(IV)}$ compounds. Various complexes were formed in nitric acid solutions, depending on the NO_3^- concentration, up to $U(NO_3)_6^{2-}$. The stability constants of the complex U nitrates were determined spectrophotographically up to a concentration of 3 g ion/liter. (TTT)

14392 ELECTROLYTIC PRECIPITATION OF AMERICIUM AND CURIUM FROM THEIR AQUEOUS SOLUTIONS ONTO A PLATINUM CATHODE. A. G. Samartseva. Radiokhimiya, 4: 696-700(1962). (In Russian)

The problem of electrolytic separation of Am and Cu from their aqueous solutions was investigated; the study resulted in the development of a quantitative electrolytic separation method of the 2 elements. The nitric acid solutions contained 1.4×10^{-10}M Am^{241} and 10^{-13}M Cm^{242}. A small Pt cup served as anode, while the Pt strip cathode with a surface of 1 cm^2 was rotated to stir the solution. The radioactive element was deposited simultaneously on both surfaces of the cathode; its concentration was calculated from the absolute counts with a 4π-counter. The electrolysis of the solution resulted in the quantitative deposition of Am at pH = 1.3 to 4.3 and of Am at pH = 1.3 to 3.0; the differential behavior is due to the hydrolysis of Cm which starts at lower pH values than Am. A deposition yield of 100% at reasonably short operational periods was obtained for both elements at a current density of 500 milliamp/cm^2. The method may be used for quantitative analytical determinations. Although anions do not exert a strong effect, solutions containing HNO_3 favor the complete separation of the two elements. (TTT)

14393 THE STABILITY OF CATIONIC NITRATE COMPLEXES OF NEODYMIUM AND YTTERBIUM. Z. A. Sheka and E. E. Kriss. Radiokhimiya, 4: 720-5(1962). (In Russian)

The extraction process of 2 lanthanide elements from nitric acid solutions by means of TBP solutions in CCl_4 was investigated for the purpose of determining the stability of the MNO_3^{2+} and $M(NO_3)_2^+$ ions where M = Nd or Yb. The TBP concentration in CCl_4 was kept at 1M while the HNO_3 concentration in the aqueous phase was varied from 0.6 to 3.0M. The results indicated that an increase of the order number of the lanthanide results in some increase of the stability of the cationic complex, contradicting the finding of I. A. Lebedev et al., (Radiokhimiya, 2: 549(1960) No. 5). The extraction of perchloric acid was so small that it may be neglected. The results agree well with those of studies carried out on the adsorption of rare earths with cationites and with the results of spectrophotometric investigations. (TTT)

14394 SORPTION OF URANIUM BY ACTIVATED CARBONS FROM SODIUM THIOCYANATE SOLUTIONS. I. A. Kuzin, V. P. Taushkanov, and V. S. Aleshechkin. Radiokhimiya, 4: 732-7(1962). (In Russian)

Sorption of high-specific activity materials on ion exchange resins results in the radiochemical degradation of the latter because of exposure to radiation. In view of the superior results obtained with inorganic sorbents, such as permutite, MnO_2, Zr phosphate, and various types of carbon, the capacity of activated carbon specimens to sorb U and other radioactive materials from Na thiocyanate solutions was further investigated. The sorption experiments on the carbon specimens, pretreated with 1M HCl were carried out under static conditions, mixing 0.5 g of C with 50 ml of the solution containing 1.35 g/liter of U for 3 to 4 days and letting the pH and the U concentration of the carbon to come to an equilibrium. The highest sorptive capacity toward U was observed when the concentration of the thiocyanate solution was kept at 0.22M. In the presence of additives, the U was selectively sorbed at pH = 1 to 2 while Th, Ce, and Ba were not sorbed. The capacity of the activated carbon ranged from 107 to 254 mg/g. Purification (decontamination) coefficients from 10^2 to 10^3 were obtained for separating U from binary mixtures containing Ce, Al, Ba, Ni, or Th. (TTT)

14395 RADIOCHEMICAL SEPARATION OF HAFNIUM WITHOUT CARRIER. N. G. Zaĭtseva and Mo-Lung Chou. Radiokhimiya, 4: 738-9(1962). (In Russian)

The currently used separation of Hf without carrier, involving sorption of $/HfCl_6/^{2-}$ on anionites, such as Dowex-1, presents experimental difficulties and therefore a method was developed for the rapid separation of Hf without carrier from the fission products of Ta. The rare earths were separated out together at the same time; they may be separated individually afterwards by chromatographic methods. The Dowex 50 × 12 resin used for sorption was centrifuged, removing the sorbed material by repeated washing with a 0.1M oxalic acid solution; the rare earths could be washed out afterwards with ammonium lactate. The Hf was ultimately precipitated on a Pt strip by electrolyzing the solution at a current density of about 70 ma/cm^2, thus preparing a target which could be conveniently used for β-spectroscopic studies. (TTT)

14396 PREPARATION OF ANTIMONY-125 WITHOUT CARRIER BY EXTRACTION WITH OXYGEN-CONTAINING SOLUTIONS. G. M. Dakar and B. Z. Iofa. Radiokhimiya, 4: 744-6(1962). (In Russian)

Irradiation of metallic Sn results in the formation of radioactive Sn isotopes and also of Sb^{125}, according to the decay scheme $Sn^{124}(n,\gamma)Sn^{125} \xrightarrow{\beta} Sb^{125} \xrightarrow{\beta} Te^{125m} \xrightarrow{\gamma} Te^{125}$

(stable). Previous studies on the separation of Sb^{125} did not take into account the distribution coefficient of microquantities of Sb^{125} and macroquantities of Sn. Experiments were therefore carried out for determining the most suitable O-containing solvent for extracting very small amounts of Sb. The work involved the determination of the distribution coefficients for microquantities of the pentavalent Sb^{125} and macroamounts of the tetravalent Sn between HCl-containing aqueous solutions and organic solvents, such as iso-amyl alcohol, diethyl ketone, di-n-butyl ether and ethyl acetate. Radiochemically pure Sb^{125} without carrier was used for the experiments together with Sn^{113} and Sn^{114}, determining the activities of the aqueous and organic phases by means of a γ-counter. It was found that the di-n-butyl ether does not extract Sn at all; it extracts only Sb. The distribution coefficients of the 2 elements were tabulated as a function of the HCl concentration. (TTT)

14397 SEPARATION OF ZIRCONIUM AND HAFNIUM BY EXTRACTION AS SUBSTITUTED AMMONIUM CHLOROMETALLATES. O. Glemser and A. v. Baeckmann (Universität, Göttingen, Ger.). Z. Anorg. Allgem. Chem., 316: 105-16(July 1962). (In German)

Zr(IV) and Hf(IV) compounds form in hydrochloric acid chloroacids which can be extracted from the inorganic phase by means of amines dissolved in organic solvents (e.g., by means of tribenzyl amine in $CHCl_3$). The partition coefficient of zirconium is greater than that of hafnium; separation factors of 10 to 20 can be achieved. By this new method, Zr and Hf compounds having only low contents of the other metal (below 0.01% Hf and Zr, respectively) were prepared in large scale by continuous and multistage separation techniques. (auth)

14398 EKSTRAKTSIYA: TEORIYA, PRIMENENIE, APPARATURA. (SBORNIK STATEI). VYPUSK 2. (Extraction: Theory, Applications, and Equipment. Number 2). A. P. Zefirov and M. M. Senyavin, eds. Moscow, Gosatomizdat, 1962. 380p.

Thirty-four papers are presented on the theory, applications, and equipment of extraction. Separate abstracts were prepared for 15 of the papers. (M.C.G.)

14399 EXTRACTION OF URANYL NITRATE FROM NITRIC ACID SOLUTIONS BY NORMAL ETHERS. V. V. Fomin and R. N. Maslova. p.19-33 of "Ekstraktsiya." Moscow, Gosatomizdat, 1962.

The solvation of $UO_2(NO_3)_2$ (using U^{233}) was studied in its extraction from aqueous nitric acid solution by di-n-butyl (DBE), ethyl-n-propyl (EPE), and di-n-propyl (DPE) ethers. With DBE the extraction of $UO_2(NO_3)_2$ from 5M HNO_3 did not change as the uranium concentration was increased from 2.13×10^{-4} to 0.12M. The solvate in the organic phase contains 1 molecule of uranyl nitrate under these conditions. With an aqueous nitrate concentration kept approximately constant, 6.3 to 6.6M, by addition of $Ca(NO_3)_2$, the distribution coefficient of uranyl nitrate and the acid concentration in the organic phase were approximately proportional to the aqueous H^+ concentration. Although uranyl trinitrate is more extractable than uranyl nitrate, the trinitrate is not likely to form under the conditions used, and the increased extraction may be due to the change in the aqueous uranyl nitrate activity coefficient and in the organic extractant and solvate activity coefficients in going from 3.15M $Ca(NO_3)_2$ to 6.3M HNO_3. With varying DBE concentrations, two solvates were shown: $UO_2(NO_3)_2 \cdot 2H_2O \cdot 2DBE$ and $UO_2(NO_3)_2 \cdot 3H_2O \cdot 3DBE$. With EPE and DPE, $UO_2(NO_3)_2 \cdot 3EPE$ and $UO_2(NO_3)_2 \cdot 3DPE$ were formed; they contained water but the amount was not determined. The logarithm of the constant of formation of uranyl trinitrate in extraction from 4.2M HNO_3 depended linearly on the ratio of the number of C and O atoms in the extractant, which agreed with earlier data for some other extractants. (TTT)

14400 EXTRACTION OF URANIUM BY A MIXTURE OF TRIBUTYL PHOSPHATE AND THE DI-ISOAMYL ESTER OF METHYL PHOSPHONIC ACID. V. V. Fomin, R. E. Kartushova, and E. P. Maiorova. p.37-46 of "Ekstraktsiya." Moscow, Gosatomizdat, 1962.

The distribution of both micro and macro amounts of uranyl nitrate (U^{233}) between aqueous solutions and two neutral extractants, tributyl phosphate (TBP) and di-isoamyl ester of methyl phosphonic acid (DAPA), and mixtures of them was studied. Equal volumes of the two phases were mixed in separatory funnels; kerosene was the diluent. With micro amounts of uranium and a constant uniform aqueous phase containing 1M nitrate ion (ammonium nitrate plus 0.05M HNO_3 to prevent hydrolysis), the distribution coefficients of the uranium were much higher with mixtures of the extractants than were the additive values. The free solvent concentration did not change, essentially, with extraction of micro amounts of uranium. The solvates $UO_2(NO_3)_2 \cdot 2DAPA$ and $UO_2(NO_3)_2 \cdot 2TBP$, together with $UO_2(NO_3)_2 \cdot DAPA \cdot TBP$, were formed. With macro amounts of uranium, each extractant formed solvates and its equilibrium concentration was less than that of the original. From 1M HNO_3 the distribution coefficients for macro amounts of uranium were only slightly higher than the additive values of those of the individual extractants. A detailed mathematical treatment is included. (TTT)

14401 THE USE OF A COMPLEX IN THE EXTRACTION PROCESS FOR RECOVERING A RARE EARTH Er–Lu CONCENTRATE. V. F. Eskevich and P. M. Seredenko. p.112-16 of "Ekstraktsiya." Moscow, Gosatomizdat, 1962.

A process is outlined (with both batch and continuous countercurrent schematic flowsheets) for recovering the Er–Lu rare earths by liquid-liquid ion exchange, i.e., by extraction with ethylenediamine tetraacetate (EDTA). This reagent can be used in a pH range from 2 to 9. In experiments on extraction by 100% TBP (tributyl phosphate) at pH 2.3 from an aqueous phase containing 800 g of NH_4NO_3 per liter as salting-out agent, the rare earth distribution coefficient was high. However, rare earth solubility in this aqueous feed is low and stable emulsions are formed in the extraction. With Trilon B (dihydrate of the EDTA disodium salt, solubility 10 to 25 g/liter at pH 1.5 to 4.0) added to the solvent, three equal-volume extractions were sufficient to recover 85 to 90% of the Er–Lu group. Back-extraction was with TBP. (TTT)

14402 MECHANISM OF EXTRACTION DISTRIBUTION OF THE RARE EARTH ELEMENTS IN NEUTRAL SOLUTION. G. V. Korpysov, I. V. Eskevich, E. N. Patrusheva, V. V. Erchenkov, and L. R. Alekseeva. p.117-40 of "Ekstraktsiya." Moscow, Gosatomizdat, 1962.

The mechanism of extraction of the rare earths by some phospho-organic solvents from aqueous containing just enough acid to prevent hydrolysis was studied. The organics were tributyl phosphate (TBP), the di-isoamyl ester of methyl phosphinic acid, $(C_5H_{11}O)_2POCH_3$ (DAPA), and toluene and benzene as diluents. As the total rare earth concentration increased from 100 to 150 g/liter, extraction of both the total rare earths and of the individual elements of the cerium sub-group increased. The maximum rare earth capacity of 100% TBP is 190 to 200 g/liter and of 70%, 140 g/liter. The mole ratio of organic to rare earth was the

same with individual rare earths as with a concentrate. With increasing amounts of salting-out agent, the distribution coefficient of micro amounts of rare earths increased. The capacity of the organic phase was greater than that of TBP. Saturation of the organic phase was approached with a salting-out agent (Al, Zn, Li). The mole ratio of TBP to rare earth, which is 3:1 for 100% TBP with the cerium subgroup elements, sometimes went as low as 1:1 with dilution of the TBP to 20% with benzene. It was verified that for the cerium elements in neutral solution, inversion does not occur with increasing nitrate ion concentration or, actually with increasing concentration of salting-out agent or rare earth nitrates. The overall rare earth distribution coefficient decreased slightly with increasing temperature in the presence of a salting-out agent, a little more without salting-out agent at high equilibrium concentrations of rare earths in the aqueous phase. However, changing the temperature greatly affected the distribution of the more extractable elements. A plot of the distribution coefficient vs. the atomic number showed that the distribution coefficient at first decreased (cerium subgroup), went through a maximum, and then fell (yttrium subgroup). Under some conditions, e.g., 100% TBP and 6N $Al(NO_3)_3$ as salting-out agent, a definite break occurred in the curve at gadolinium. A mathematical treatment of the data is included. (TTT)

14403 EXTRACTION OF ZIRCONIUM AND HAFNIUM BY TRI-N-OCTYLAMINE FROM METAL FLUORIDE SOLUTIONS. G. A. Yagodin and A. M. Chekmarev. p.141-53 of "Ekstraktsiya." Moscow, Gosatomizdat, 1962.

Tri-n-octylamine (TOA), 10% in benzene, did not extract zirconium or hafnium from their aqueous potassium fluoride solutions in the absence of acid. In the presence of acid both metals were extracted, the distribution coefficient varying with the acid used, decreasing in the order $H_2SO_4 \rightarrow HCl \rightarrow HNO_3$. With H_2SO_4 solutions, extraction by 10 vol % TOA in benzene was maximum for both metals with an initial aqueous acidity of 0.2 to 0.3N. From sulfuric acid solution, hafnium was principally extracted, and from nitric acid, zirconium. From HCl the distribution coefficients were not large, and, depending on the acid concentration, might be greater or less than 1. The effect of impurities was shown by extraction from a solution containing 8.7 g of K_2ZrF_6 per liter by 5% TOA in benzene, the amine being previously saturated with H_2SO_4. With increasing KCl, NH_4NO_3, K_2SO_4, or KF in the solution the distribution coefficient decreased. In the presence of 0.2M oxalic acid and with 10 g of K_2ZrF_6 per liter (the amine not previously treated with sulfuric acid), the zirconium distribution coefficient was nearly 5 times that of hafnium. The extraction mechanism involved transfer of the zirconium and fluoride, but not the potassium, from the aqueous K_2ZrF_6 solution to the organic phase, 1 mole of zirconium combining with 2 moles of amine: $2(NR_3H)HSO_{4\,org} + K_2ZrF_{6aq} \rightleftharpoons (R_3NH)_2ZrF_{6org} + 2KHSO_{4org}$. The logarithm of the zirconium coefficient plotted against that of the TOA concentration was a straight line with slope of approximately 1. The diluted (with benzene) TOA bisulfate is believed to be polymerized. (TTT)

14404 DISTRIBUTION OF THORIUM AND RARE EARTHS IN TRIBUTYL PHOSPHATE EXTRACTION. G. E. Kaplan, S. D. Moiseev, V. M. Gavrilin, G. I. Semenov, and V. P. Vorotilin. p.154-9 of "Ekstraktsiya." Moscow, Gosatomizdat, 1962.

In experiments on extraction with 40% tributyl phosphate (TBP) from aqueous solutions containing 30 to 130 g of thorium per liter, the thorium distribution coefficient increased with increasing HNO_3 concentration in the aqueous phase from 1 to 5M and then dropped, especially sharply for the 30-g/liter concentration. An increased rare earth concentration in the initial solution somewhat increased the thorium distribution coefficient, apparently by a salting-out effect, with increase also in the extracted rare earths. The chief disadvantage of using a solution with a high rare earth content is the inability to increase the thorium content as much as desirable because of the high viscosity of the solution caused by the high concentration of the total components. The extract was washed many times with 3.7 to 4.0N HNO_3, and the rare earth content in the final extracted product, which contained from 97.5 to more than 99% of the original thorium, was 10^{-3} to 10^{-4}%, based on thorium. The experiments were made in a 12-stage countercurrent mixer-settler. (TTT)

14405 EXTRACTION OF THORIUM BY DI-ISOAMYL ESTER OF METHYL PHOSPHONIC ACID FROM HYDROCHLORIC AND PERCHLORIC ACID SOLUTIONS. V. D. Nikol'skii and M. E. Pozharskaya. p.160-4 of "Ekstraktsiya." Moscow, Gosatomizdat, 1962.

The distribution of thorium between aqueous HCl and $HClO_4$ solutions and solutions of di-isoamyl ester of methyl phosphonic acid (DAPA) in CCl_4 was studied. Equal-phase volumes, 4 ml each, were used in graduated test tubes. DAPA extracted $HClO_4$ solutions much better than HCl. The solubility of perchloric acid in DAPA was practically negligible. From 5M HCl, with increase in aqueous thorium from 1 to 230 g/liter, the distribution coefficient decreased with 20 and 50 vol % DAPA but changed slightly and irregularly with 10%. With 10, 30, and 50 vol % DAPA in CCl_4, the distribution coefficient of thorium increased linearly with increasing HCl concentration from 0.2 to 4M, but above 5M HCl the distribution coefficient increased abruptly. This may be due to the formation of a new, readily extractable, compound, e.g., $HThCl_8$, H_2ThCl_8, H_4ThCl_8, or to the increased salting-out effect of the HCl. In low-acid solutions the thorium was shown to be in the form of the ions $ThOH^{3+}$, $Th(OH)_2^{++}$, and $Th(OH)_3^{+}$ and was extracted chiefly as $Th(OH)Cl_3.n$DAPA. At 5M HCl the neutral salt $ThCl_4$ is formed, which is extracted better than the basic salt. From perchloric acid varying from 1.0 to 6.0M, the distribution coefficients of thorium from a solution containing 20 g of thorium per liter were similar to those from HCl but a little higher. (TTT)

14406 EXTRACTION OF URANYL NITRATE BY TRIBUTYL PHOSPHATE AND OTHER NEUTRAL PHOSPHO-ORGANIC COMPOUNDS FROM NITRIC ACID ELUATES. B. N. Laskorin, D. I. Skorovarov, and V. V. Shatalov. p.174-8 of "Ekstraktsiya." Moscow, Gosatomizdat, 1962.

Extraction of uranyl nitrate from low-acid eluates, obtained from ore pulps, by alkyl phosphate (TBP), alkyl phosphonates (DAPA), trioctyl phosphine oxides (TOPO), and other compounds in this series was studied. The sulfate in solutions prepared by sorption of uranium from ore pulps and elution with dilute nitric acid may be kept low by sufficient washing of the resin before elution. Uranium may be completely extracted by 30% TBP in kerosene in 5 stages from an eluate containing 10 g of SO_4, 40 g of HNO_3, and 20 g of NO_3 per liter. The NO_3/SO_4 mole ratio should not be less than 8. Study of the properties of a series of phospho-organic compounds showed that with increase in the number of C-P bonds, the extraction capacity for uranium increases. The distribution coefficient of uranium was higher with 10% DAPA than with 40% TBP or 1% TOPO plus 40% TBP from an acid solution containing 45 g of acid per liter. With a mixture (e.g., 1% TOPO plus 40% TBP or 5%

DAPA plus 35% TBP) pure uranium solution may be obtained. The total impurity in the uranium oxide obtained by this method was not more than 0.1 to 0.2%. The loss of extractant was almost directly proportional to the volume of aqueous solution processed, but a large part of the lost extractant could be recovered by washing the mother liquor with kerosene. (TTT)

14407 SYNERGISM IN THE EXTRACTION OF URANYL NITRATE. V. B. Shevchenko, V. S. Smelov, and A. V. Strakhova. p.179-89 of "Ekstraktsiya." Moscow, Gosatomizdat, 1962.

Extraction of uranyl nitrate from nitric acid solutions by acid (dibutyl, DBP, and di-isoamyl) and neutral (tributyl, TBP) phosphates was studied in glass separatory funnels at 22°C. Equal phase volumes were used. The diluent was thiophene-free benzene. The synergistic effect increased as the TBP in the organic phase increased and approached a maximum of about 6 for a TBP-DBP mixture and about 8 for a TBP-di-isoamyl phosphate mixture. The TBP was varied from 50 to 8000% of the stoichiometric amount needed to form the uranyl nitrate disolvate. A change in the dialkyl phosphate concentration to 1- to 2-fold excess over stoichiometric did not affect the synergistic effect, but the effect was decreased somewhat with much lower dialkyl phosphate concentrations. With low HNO_3 concentrations, with a mixture of TBP and either DBP or di-isoamyl phosphate, the synergistic effect sharply increased to a maximum and then fell. Changing the uranium concentration from 1 to 50 g/liter did not affect the synergism under the conditions. The extraction mechanism with a mixture of extractants appears to be extraction of a complex containing 1 mole of TBP: $UO_2^{++} + 2HA \rightleftharpoons UO_2A_2 + 2H^+$ and $UO_2A_2 + TBP \rightleftharpoons UO_2A_2.TBP$. (TTT)

14408 EXTRACTION OF URANYL SULFATE BY TRI-N-OCTYLAMINE. B. N. Laskorin, Z. Sh. Golynko, and D. I. Skorovarov. p.190-8 of "Ekstraktsiya." Moscow, Gosatomizdat, 1962.

The mechanism of extraction of uranyl sulfate by tri-n-octylamine (TOA) was studied. The TOA was dissolved in sulfonated kerosene to 0.16 to 0.46M and contained 5 vol % decyl alcohol. The aqueous uranyl sulfate solutions had uranium concentrations of 1.06 to 60.67 g/liter and a pH of 1. Equilibrium in extraction was reached in 20 to 40 sec. At equilibrium the TOA/U ratio was 4.8. For an organic phase far from saturated, the distribution coefficient was directly proportional to the free amine concentration. Near saturation conditions, a uranyl aminosulfate complex formed with practically constant ratio of uranyl sulfate and aminosulfate. A characteristic of TOA is its ability to quickly approach saturation of the organic phase with low equilibrium concentrations of uranium in the aqueous phase. The optimum conditions for extracting uranium from sulfuric acid media is a TOA/U weight ratio of 8 to 9. Further increase in the ratio does not increase the extraction. With a TOA/U weight ratio less than 5, the uranium distribution coefficient decreases, and it is difficult to obtain a low equilibrium uranium concentration in the aqueous phase. Extraction and ion exchange properties are very similar, and quantitatively the extraction isotherm may be determined from the equations for ion exchange processes. (TTT)

14409 DENSITY, VISCOSITY, SURFACE TENSION OF SOLUTIONS AND DIFFUSION COEFFICIENTS OF SUBSTANCES IN THE WATER–URANYL NITRATE–NITRIC ACID–TRIBUTYL PHOSPHATE SYSTEM. E. V. Voronetskaya and A. M. Rozen. p.199-208 of "Ekstraktsiya." Moscow, Gosatomizdat, 1962.

Various constants were measured for use in analyzing mass transfer and hydrodynamic data in extraction columns. The extractant was TBP in kerosene. At 20°C, with increase in the TBP concentration from 0 to 100%, the surface tension at the aqueous-air interface varied from 50 to 35 dynes/cm, at the organic-air interface from 25 to 28 dynes/cm, and at the organic-aqueous interface, from 22 to 9 dynes/cm. TBP had a higher surface activity than kerosene. HNO_3, which lowered the surface tension of the H_2O, in the presence of organic phase somewhat increased the surface tension of the aqueous phase and of the interphase at concentrations of the order of 10M. The surface tension of uranyl nitrate at the boundary with air was higher than with water. In the system aqueous uranyl nitrate solution plus nitric acid–20% TBP in kerosene, the surface tension of the equilibrium organic phase and interphase tension increased with increasing uranium concentration, especially in the presence of 2M HNO_3. From 20 to 60°C, the surface tension of the aqueous and organic phases at the air boundary decreased linearly with increasing temperature. The interphase tension increased linearly. Clean surfaces were poorly wet by 20% TBP in kerosene. Tables and graphs show the viscosity and specific gravity values for various solutions under various conditions, and diffusion coefficients for uranyl nitrate in the aqueous and organic phases are recorded. (TTT)

14410 EFFECT OF MONO- AND DIBUTYL PHOSPHATES ON EXTRACTION OF URANIUM(VI) BY TRIBUTYL PHOSPHATE. V. B. Shevchenko and V. S. Smelov. p.219-26 of "Ekstraktsiya." Moscow, Gosatomizdat, 1962.

Since dibutyl (DBP) and monobutyl (MBP) phosphates, decomposition products of tributyl (TBP) phosphate, have a tendency to transfer to the aqueous solution, their distribution coefficients between benzene and aqueous solutions containing varying amounts of nitric acid, lithium nitrate, and perchloric acid (ionic strength of 4) were investigated. DBP transferred in insignificant amounts to aqueous solutions containing $LiNO_3$, HNO_3, and $HClO_4$, especially at high concentrations of the last. MBP transferred readily, the amount increasing with increasing acidity. Extraction of uranium by 20% TBP in kerosene was strongly affected by DBP but was essentially not affected by MBP. The distribution coefficient of uranium between the benzene and aqueous solutions varied as the square of the MBP and DBP concentrations and inversely as the hydrogen ion concentration. Varying the nitrate ion concentration in the range 1 to 3M had practically no effect. The proposed mechanism is: $UO_{2aq}^{++} + 2HA_{org} \rightleftharpoons UO_2A_{2org} + 2H_{aq}^+$. (TTT)

14411 EXTRACTION DISTRIBUTION OF VANADIUM AND URANIUM. V. I. Kuznetsov and I. V. Seryakova. p.227-34 of "Ekstraktsiya." Moscow, Gosatomizdat, 1962.

For use in analyzing solutions for uranium, optimum conditions were determined experimentally for separating a large amount of vanadium(V) from uranium. The vanadium was extracted from a H_2SO_4-HCl medium, which permitted making a "superconcentrated" HCl medium while increasing the vanadium extraction by tying up some of the other elements, especially the uranium, in a sulfate complex. In the proposed method, concentrated H_2SO_4 and HCl are added to 5 to 10 ml of solution to be analyzed. This solution should contain no more than 0.5 to 1.0N chloride and nitrate and its vanadium content should be 100 to 150 mg. The vanadium is extracted with amyl acetate plus tolu-

ene, and the residual acid solution is oxidized with solid $KClO_3$ and again extracted. After four extractions, 94 to 96% of the original uranium remains in the acid layer and less than 0.05% of the vanadium. (TTT)

14412 ON THE THERMODYNAMIC EXTRACTION EQUILIBRIUM OF PLUTONIUM. A. M. Rozen and E. I. Moiseenko. p.235-56 of "Ekstraktsiya." Moscow, Gosatomizdat, 1962.

The activity coefficient for micro amounts of Pu(VI) in extraction by 20% tributyl phosphate (TBP) from aqueous solutions ranging in acidity from 0.1 to 10M and in uranium concentration from 0 to 400 g/liter was close to that of U(VI), as were values for micro amounts of Pu(IV) in the presence of HNO_3, Th(IV) in macro concentration, and Pu(IV) in macro concentration. A sharp drop with increasing nitrate ion concentration is explained by the action of electrostatic forces. An increased activity coefficient at high temperatures is probably connected with decreased association. The higher activity coefficient of macro amounts of plutonium at high ion strength may be explained by the greater hydration of plutonium than of hydrogen ions. When the aqueous solution contains uranium, it transfers to the organic, tying up TBP and decreasing the plutonium distribution coefficient. In the absence of uranium, at acidities up to about 6M the Pu(IV) distribution coefficient decreased with increasing temperature but at higher acidities, increased. At acidities from 0.1 to 10M, with an aqueous uranium concentration higher than 5 g/liter, Pu(IV) extraction increased with increasing temperature. Because of the decreasing uranium distribution constant under these conditions, the free TBP concentration increased, overlapping the effect of the lower Pu(IV) distribution constant. With only 5 g of uranium per liter of aqueous phase, Pu(IV) extraction showed a maximum with temperature. Of eight diluents tested, CCl_4 caused the least deviation from theoretical, $CHCl_3$ the most. Measurements in the HNO_3-HClO_4-1M TBP (in benzene) and the $CuCl_2-Cu(NO_3)_2-20\%$ TBP systems indicated that less than 4 nitrate ions are in the Pu(IV) complex. With increasing temperature from 20 to 70°C, the complex formation constant decreased, in agreement with an electrostatic explanation. With macro plutonium concentrations, extraction from 0.1M HNO_3 increased with increasing plutonium concentration up to 250 g/liter, the increase being considerably greater with 100% than with 20% TBP. With 0.72M TBP, benzene diluent gave the best results in extraction, out of four tried. Increased acidity increased the plutonium in the organic, especially at low concentrations. The di-isoamyl ester of methyl phosphonic acid and TBP were much better extractants than diethyl or dibutyl ether. Measurements of the heat effect showed 5700 ± 200 cal/mole for extraction of $Pu(NO_3)_4$ by TBP. (TTT)

14413 MASS TRANSFER IN EXTRACTION AND STRIPPING OF URANYL NITRATE IN PACKED COLUMNS. A. M. Rozen, S. M. Karpacheva, S. F. Medvedev, E. P. Radionov, and L. F. Kiseleva. p.284-93 of "Ekstraktsiya." Moscow, Gosatomizdat, 1962.

The effectiveness of packing in the column was studied for the extraction of uranyl nitrate by tributyl phosphate. HETS and HTU values are presented in graphs for various extraction and stripping conditions. The extraction experiments were carried out with a 25-mm diameter, 1-m high laboratory column, while for the reextraction 2 and 5.8-m high columns were used; details of the experiments were similar to those described by A. Rozen et al., (Khim. Prom. 627 (1957) No. 7). The U concentration of the uranyl nitrate solutions was varied from 1 to 310 g/liter during the extraction step and from 10 to 70 g/liter during the reextraction while the HNO_3 concentration was kept at about 0.5 and 2M during the extraction; for the re-extraction distilled water acidified with 0.05M HNO_3 was used. (TTT)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

Refer also to abstracts 15416 and 15520.

14414 (ACNP-62033) STEAM SEPARATION TECHNOLOGY UNDER THE EURATOM PROGRAM. Quarterly Progress Report, October 1, 1962–December 31, 1962. (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). Jan. 10, 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(11-1)-1186. 120p. (EURAEC-543)

To fully understand the hydrodynamic principles governing flow of an air-water mixture in centrifugal type down flow separators, operation of the air-water column was continued. Concentration this quarter was on the discharge nozzle and separator regions. Computer programs were prepared to describe flow in these regions. Tests performed on a full size 10-in.-dia. separator verified the computer results. Considerable test data, describing the separator's overall performance were recorded. The auxiliary air-water test apparatus was converted, to model the downcomer in natural circulation systems. The gamma-ray attenuation method to measure void fractions in the downcomer region was used. Results show a gradient exists in the vertical void fraction distribution. The air-water test tank and test equipment was fabricated and installed. The first test program, an evaluation of the effectiveness of a necked-down riser as a means of reducing carryunder, is in progress. Fabrication of the pressure vessel for the high pressure steam-water loop is in progress. Most instrumentation for loop operation and test measurements was received. (auth)

14415 (DP-812) APPLICATION OF MOISTURE SEPARATORS AND PARTICULATE FILTERS IN REACTOR CONTAINMENT. Albert H. Peters (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Dec. 1962. Contract AT(07-2)-1. 68p.

Tests showed that water-repellant particulate filters downstream of moisture separators in the exhaust air system of a water-moderator-and-cooled nuclear reactor remove 99+% of radioactive particles that may be released during a containable accident. Separators and filters were undamaged when exposed for 30 sec to wet steam flow of 7000 scfm/filter followed by 10 days exposure to steam-air-entrained H_2O mixtures at about the nominal filter capacity of 1000 scfm/filter. (auth)

14416 (HW-57581(Del.)) MECHANICAL SEALS FOR ORGANIC FLUIDS. First Phase Report, June 1, 1958. H. L. Floyd (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 1, 1958. Contract [AT(45-1)-1350]. 9p.

The solvent action of organics, their tendency to leak, and the difficulty in maintaining a packed stuffing box in a radiation zone indicates that another type of pump shaft seal is desirable. Mechanical seals of several designs and a canned rotor pump have been investigated. Information from tests supports the belief that a mechanical seal is a durable and reliable apparatus if installed with precision. The canned rotor pump proved completely satisfactory and operated >1200 hr without incident. (H.G.G.)

14417 (HW-68067(Rev. 1)) SPECIFICATION—HEATER, ELECTRIC, RESISTANCE, SHEATHED, FOR NUCLEAR SERVICE. Bert S. Kosut (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 10, 1962. Contract [AT(45-1)-1350]. 23p.

Design, manufacture, and test requirements are delineated for cylindrical, alumina- or magnesia-sheathed, grounded-type, electrical resistance heaters, for nuclear service at elevated temperatures and pressured, in contact with water, liquid, metals, or gaseous atmospheres. Specifications are also included for austenitic stainless steel tubing for use as heater sheaths for nuclear service under the described conditions. (T.F.H.)

14418 (HW-74572) SPECIFICATION FOR ELECTRICAL RESISTANCE HEATER [FOR] NUCLEAR SERVICE. B. S. Kosut (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 24, 1962. Contract AT(45-1)-1350. 5p.

The specifications for the design, manufacture, and testing of cylindrical, sheathed, grounded electrical resistance heaters for nuclear service at high temperatures and pressures in contact with water, liquid metals, or gaseous atmospheres are presented. (H.G.G.)

14419 (HW-SA-2930) APPLICATION OF CENTRALIZED REMOTE CONTROL EQUIPMENT TO PRIMARY ELECTRICAL SUBSTATIONS SUPPLYING RICHLAND REACTORS AND PRODUCTION FACILITIES. R. Thompson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 26, 1963. Contract AT (45-1)-1350. 12p.

The application of supervisory control equipment to the Hanford electrical system that will permit remote control and operation of all substations from the dispatching office shows every indication of success. No safety problem will be created by this type operation, and pilot plant operations indicate that all the functions needed for speedy and reliable operation can be performed. All testing or monitoring can be handled by supervisory control or by roving substation operators. The operation of remote units from a central point will permit better, more effective supervision of the primary substations and reduce annual operating costs. (H.G.G.)

14420 (LAMS-2797) EPOXY POTTING SYSTEMS FOR HIGH VOLTAGE, HIGH AMPERAGE CIRCUITRY. E. Philip Ehart and James S. Church (Los Alamos Scientific Lab., N. Mex.). Aug. 15, 1962. Contract W-7405-eng-36. 27p.

Practical solutions were developed for problems involved in the potting of electrical coils for use at high voltage and high amperage. Specific epoxy resin-fiberglass combinations are discussed as well as the particular requirements for which they were formulated. No attempt at theoretical analysis of the materials system was made, and no abstract property evaluation tests were performed. Because of the unique nature of the actual problems, there was no need to find a solution which could be conveniently adapted to fabrication of a number of duplicate units. The methods developed are not well-suited to quantity production processing. (auth)

14421 (RFP-302) PRELIMINARY TEST ON AXIAL SPINDLE EXPANSION OF NUMBER 739 EX-CELL-O NUMERICAL TAPE CONTROL MACHINE. J. H. Krine (Dow Chemical Co. Rocky Flats Div., Denver). Feb. 19, 1963. Contract AT(29-1)-1106. 10p.

Axial spindle expansion of an Ex-Cell-O numerical tape control machine was measured to evaluate the effect of such

expansion during precision machining of various contours. (auth)

14422 (RT/ING(62)-1) PROGETTO DI UN RIG PER PROVE DI IRRAGGIAMENTO n-γ SU CAMPIONI DI ZINCO E RAME. (Design of an Experimental Rig for the n-γ Irradiation of Samples of Zinc and Copper). G. Bianchi, V. Debicke, and L. Matteuzzi (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). Dec. 1962. 21p.

The design of an experiment rig to be installed in the 4 DH6 irradiation facility of the Ispra-1 reactor is described. The purpose of the experiment is the investigation of radiation damage effects in metallic monocrystal samples of Cu, Zn, and their alloys, under n-γ irradiation. (auth)

14423 (TID-16291) HIGH PRESSURE PUMP SEAL DEVELOPMENT. Engineering Monthly Progress Report, June 1962. Robert C. Hajner (Worthington Corp. [Advanced Products Div.], Newark, N. J.). July 5, 1962. Contract AT(30-1)-2682. 8p.

Type I pump seals were subjected to various operating pressures for predetermined time intervals. Sixty starts and stops were included in the test program. Both the rotor and stator seal faces were made of aluminum oxide, which is very hard, tough, and highly resistant to wear. Its electrical insulating quality is highly desirable as it overcomes the electrolytic corrosion problem commonly associated with carbon face seals. Examination of the seal faces after testing revealed wear on both the stator and rotor faces in the range of 4 lightbonds and several circumferential scratches less than 0.001 in. deep on both faces. These scratches did not affect the normal operation of the seal at any time during the test. (H.G.G.)

14424 (WAPD-T-1482) INTERPRETIVE REPORT OF PRESSURE VESSEL RESEARCH. SECTION 1.3—BURSTING STRENGTH. B. F. Langer (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Feb. 1962, Corrected June 1962. Contract [AT(11-1)-Gen-14]. 38p.

Plastic behavior and bursting strength of pressure vessels are discussed. Comparisons are made between theoretical and experimental results and a simple set of formulas for bursting strength is recommended for general use by designers. These formulas require only the nominal ultimate tensile strength and the uniform elongation of the material to be known and are expected to be accurate to within 10% in most cases. (auth)

14425 (AERE-Trans-915) PRODUCTION OF VACUUM BY CONDENSATION ON LOW-TEMPERATURE SURFACES. I. CRYOGENIC PUMPS. G. Klipping and W. Mascher. Translated by R. Todd (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Vakuum-Tech., 11: No. 3, 81-5(1962). 15p.

Physical principles that form the basis for vacuum production by gas condensation on low temperature surfaces are discussed. The facilities that make available the required cooling media on a commercial scale are surveyed, leading to the basic conceptions for the design and operation of cryogenic pumps. The cryogenic pump has the advantage over conventional vacuum pumps of producing high and ultra-high vacuum with a relatively simple mode of operation. It has a high specific pumping speed over the entire vacuum range and contains no heating element that could cause decomposition of hydrocarbons. The low cost relative to high pumping speeds achieved insures economic operation. The simplest cryogenic pump consists of a low temperature trap charged with liquid hydrogen or helium. (H.G.G.)

14426 SOLAR CELL PERFORMANCE IN THE ARTIFICIAL RADIATION BELT. Robert E. Fischell (Johns Hopkins Univ., Silver Spring, Md.). AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 242-5(Jan. 1963).

As a result of the high altitude nuclear test performed over Johnston Island on July 9, 1962, an intense electron radiation belt has been created. The electrons in this artificial belt have a sufficiently high energy and density to impair seriously the operation of solar cell power generating systems. Special solar cell panels on the Transit 4B and TRAAC satellites have shown a 22% decrease in output in a period of approximately 25 days after the high altitude nuclear test. Using solar cell data obtained from Transit 4B and TRAAC in conjunction with direct radiation measurements from other satellites, it is possible to estimate the degradation of solar power generating systems for various satellite orbits. (auth)

14427 DESIGN OF IRRADIATION ROOMS. Keisuke Kawabata, Sin'ichi Okamoto, Tatsuo Tabata, Jun'ichiro Furuta, Shigeru Okabe, Toshio Azuma, and Kiichi Kimura. Ann. Rept. Radiation Center Osaka Prefect., 1: 10-14 (1960). (In English)

The Radiation Center of Osaka Prefecture is a central research institute for the peaceful uses of radiations and radioisotopes in western Japan. The radiation sources used are multicuries Co^{60} and a 15 Mev electron linear accelerator. Calculations on the thickness of shielding walls for Co^{60} caves and the design of the linac irradiation room are reported. (H.G.G.)

14428 DEAD TIME GENERATOR AND TIME DISCRIMINATOR. G. Horn and L. Genta (SORIN, Milan). Energia Nucl. (Milan), 9: 564-9(Oct. 1962). (In Italian)

A device is described which is able to inhibit the operation of a pulse-counting chain, for predetermined constant and exact time intervals. An application of this device for the temporal discrimination of the pulses is also described. At last a description is given of the proposed device and the operation characteristics are indicated. (auth)

14429 EXPERIMENTAL INVESTIGATIONS ON IGNITION AND OPERATING VOLTAGES IN NEON–ARGON MIXTURES WITH CONSIDERATION OF REQUIREMENTS IN THE DEVELOPMENT OF COLD CATHODE DISCHARGE TUBES. D. Morawski (VEB Werk für Fernsehelektronik, Berlin). Exptl. Tech. Physik, 10: 355-62(1962). (In German)

The influence of the Penning effect on the ignition and operating voltage of a Ne–Ar mixture with neon as the basic gas was investigated in dependence on the pressure, electrode material, and percent Ar concentration. An accurate study of the effect of a new forming method on the ignition and operating voltage of the gas mixture was also made. (tr-auth)

14430 AUTOMATIC HANDLING FOR FISSILE MATERIALS. INTERLOCKING DEVICES INCORPORATED TO PREVENT ACCIDENTS. Metallurgia, 67: 31-2(Jan. 1963).

A description is given of the overhead handling system used to move reactor fuel elements from assembly bays to the reactor hall at Winfrith Heath. The system consists primarily of an endless track, and sidings are provided in the reactor hall. The operation of the system is described. (D.L.C.)

14431 AN ELECTROSTATICALLY FOCUSED ION SOURCE AND ITS USE IN A SEALED-OFF D.C. NEUTRON SOURCE. J. D. L. H. Wood and A. G. Crocker (Services Electronics Research Lab., Baldock, Herts, Eng.). Nucl. Instr. Methods, 21: 47-8(Jan. 1963). (In English)

A modification to the Penning ion source is described in which the axial magnetic field is replaced by an additional electrode which provides electrostatic focusing. The source has been used in an experimental neutron tube providing continuous outputs up to 10^8 neutrons per second. (auth)

14432 A SEALED-OFF 14 Mev NEUTRON SOURCE INCORPORATING A SOLID STATE ALPHA-PARTICLE DETECTOR. J. D. L. H. Wood (Services Electronics Research Lab., Baldock, Herts, Eng.). Nucl. Instr. Methods, 21: 49-52(Jan. 1963). (In English)

A silicon diffused-junction alpha-particle counter was incorporated as a self-calibrating facility in a sealed-off neutron tube employing the deuterium-tritium reaction. Detection of the alpha particles associated with this reaction provides a direct measure of neutron output uninfluenced by environment. Proportionality of alpha counts with neutron level was demonstrated over the range 10^4 to 10^8 neutrons per second. (auth)

14433 OPERATIONAL CHARACTERISTICS OF A RADIO FREQUENCY ION-SOURCE. A. K. Ganguly and H. Bakhru (Saha Inst. of Nuclear Physics, Calcutta). Nucl. Instr. Methods, 21: 56-64(Jan. 1963). (In English)

A radiofrequency type ion source using a 30 Mc/s oscillator was designed with co-axial magnetic field and its operational characteristics are measured, taking oscillator power, gas pressure, magnetic field, probe voltage, and canal geometry as independent parameters. From these graphs, correlations were made with the internal phenomena of the gas discharge and of ion extraction. A maximum beam current of 8 ma at 6 kv extraction voltage was obtained. Some of the limitations and improvements on this ion source are discussed. (auth)

14434 NUCLEONICS ROUNDTABLE: TRENDS IN HOT CELL DESIGN. Nucleonics, 21: No. 3, 66-71(Mar. 1963).

Aspects of design and operation of hot cells are discussed. Alpha-gamma shielding, cell sealing, α-n-γ activation, filters, and manipulator installation are specifically treated. Application of hot cell research to space and undersea work is briefly discussed. (D.C.W.)

14435 VAPOR SOURCES FOR VACUUM DEPOSITION OF SUPERCONDUCTIVE THIN-FILM CIRCUITRY. Arthur J. Learn and R. Spencer Spriggs (Space Technology Labs., Inc., Redondo Beach, Calif.). Rev. Sci. Instr., 34: 179-82(Feb. 1963).

Radiatively heated ovens were used as vapor sources for vacuum deposition of superconductive films, primarily tin and lead. They delivered uniform deposition rates in the entire range tested from tenths of angstroms per second to ~100 Å/sec. For the experimental arrangement employed, a deposition rate of 1 Å/sec is found by calculation to correspond to an effusion rate from the oven of 2×10^{-5} moles/cm^2/sec. By effectively reducing the length of the oven opening to zero and increasing the ratio of oven diameter to opening diameter to about four, emission characteristic of a surface source was obtained for the same range of deposition rates. For one such oven of typical dimensions, a chart is included by use of which compromise may be made between effective source enlargement, due to self-scattering effects at the source, and deposition rate. (auth)

14436 STUB-TUNER IMPEDANCE MATCHING IN A HELIUM CRYOSTAT. J. de Klerk (Westinghouse Research Labs., Pittsburgh). Rev. Sci. Instr., 34: 183(Feb. 1963).

When a microwave cavity in coaxial systems is operated in a helium cryostat, optimum coupling of cables to the cavity involves impedance matching between the cables and the cavity. This matching problem is solved by a right-angle stub tuner which can be operated in liquid helium. (D.L.C.)

14437 HIGH VACUUM DEPOSITION OF CESIUM. F. G. Allen and G. W. Gobeli (Bell Telephone Labs., Inc., Murray Hill, N. J.). Rev. Sci. Instr., 34: 184-5(Feb. 1963).

An apparatus for depositing cesium on a clean surface in ultra-high vacuum is described which deposits ions only on the desired surface and permits exact monitoring of the cesium dosage. In the apparatus, cesium atoms from an oven are collimated into a beam which is ionized by impact on hot tungsten ribbon and swept to the desired surface by a negative collecting voltage. (D.L.C.)

14438 ABILITY OF A VOLTAGE-GRADED SURFACE TO SUPPORT A HIGH VOLTAGE IN VACUUM AND IN A PRESSURIZED GAS. R. B. Britton, K. W. Arnold and A. S. Denholm (Ion Physics Corp., Burlington, Mass.). Rev. Sci. Instr., 34: 185-7(Feb. 1963).

A bushing with a voltage-graded surface was constructed from aluminum and Pyrex glass rings. The bushing, 30 cm long, supported ~10^6 v at p = 10^{-4} mm Hg and ~8×10^5 v at p = 10^{-7} mm Hg of SF_6. The application of voltage grading to pressurized gases is considered; a 25-cm stack of aluminum-glass rings was found to support more than 10^6 v in 150 psia of $N_2 + CO_2$. (D.L.C.)

14439 PREPARATION OF UNBACKED CADMIUM FOILS OF APPROXIMATELY 50 μg/cm^2. W. Meckbach (Centro Atomico Bariloche, San Carlos de Bariloche, Argentina and Univ. of Chicago). Rev. Sci. Instr., 34: 188-90(Feb. 1963). (EFINS-62-34)

A method is given for preparing thin Cd foils by evaporation of Cd on plastic layers and subsequent dissolution of this plastic backing. The difficulty of Cd deposition in vacuum was removed by first evaporating a very small amount of gold in the vacuum apparatus, whereby Cd deposits readily on this gold. A device for dissolving the plastic backing is described. (D.L.C.)

14440 SIMPLE 25-kv TARGET MODULATOR SWEEP CIRCUIT. J. B. S. Waugh and J. H. Carver (Australian National Univ., Canberra). Rev. Sci. Instr., 34: 192-3 (Feb. 1963).

An inexpensive sweep circuit was designed for modulation of the target potential in a high-energy accelerator. The circuit includes a sweep generator and a sampler or linear gate circuit. The performance of the circuit is illustrated with the resonances of the $Al^{27}(p,\gamma)$ reaction. (D.L.C.)

14441 TEMPERATURE REGULATOR AND SAMPLE CHANGER FOR NEUTRON TOTAL CROSS-SECTION MEASUREMENTS AT LOW TEMPERATURES. A. M. Kistner and O. C. Kistner (Columbia Univ., New York and Brookhaven National Lab., Upton, N. Y.). Rev. Sci. Instr., 34: 194-6(Feb. 1963). (BNL-6475)

An apparatus was designed for alternating the sample with open beam counts in neutron transmission measurements at any temperature down to 78°K. The apparatus comprises a stainless steel Dewar, a sample-changing mechanism, a liquid-N_2 injection system, and temperature-control and injection-timing circuitry. (D.L.C.)

14442 SIMPLE 20-A POWER SUPPLY FOR SUPERCONDUCTING MAGNETS. B. R. McAvoy (Westinghouse Research Labs., Pittsburgh). Rev. Sci. Instr., 34: 200-1 (Feb. 1963).

A simple transistor power supply is designed which has a stability of 0.5%/hr. The supply may be described as a d-c power amplifier without feedback, and the rate at which the current is built up or reduced can be regulated. A tripout circuit is provided for shutting off the supply if the magnet "goes normal." (D.L.C.)

14443 PORTABLE THERMOELECTRIC GENERATORS. A. Bayne Neild, Jr. (Naval Engineering Experiment Station. [Annapolis]). Preprint 645A. Detroit, Society of Automotive Engineers, 1963. 9p. $1.00.

Paper from Automotive Engineering Congress, Detroit, Jan. 1963.

The inherent advantages of quiet operation, few moving parts, and compact and lightweight construction make thermoelectric generators desirable for powering certain specialized military equipment. Recent developments in thermoelectric materials, couple designs, and couple compartment fabrication have shown promise for successful generator sizes that can meet present needs for portable power up to 500 w. (auth)

14444 ENERGY SOURCES FOR THE FUTURE. Paul H. Egli (Naval Research Lab., Washington, D. C.) and George W. Sherman. Preprint 645B. Detroit, Society of Automotive Engineers, 1963. 19p. $1.00.

Paper from Automotive Engineering Congress, Detroit, Jan. 1963.

The search for new means of providing power includes a variety of static processes for converting heat to electricity; utilization of solar energy by photoprocesses; new electrochemical processes as conventional batteries, fuel cells and thermally regenerative systems; and dynamic engines operating at extreme limits. Most of the effort is directed toward military and space requirements, and adequate solutions for most of the problems appear likely. Immediate use of the new processes in vehicle propulsion seems unlikely, but developments are in sight which could ultimately have a large industrial impact. (auth)

Heat Transfer and Fluid Flow

Refer also to abstract 14468.

14445 (ANL-6653) TRANSIENT ANALYSIS OF TWO-PHASE NATURAL-CIRCULATION SYSTEMS. R. P. Anderson, L. T. Bryant, J. C. Carter, and J. F. Marchaterre (Argonne National Lab., Ill.). Dec. 1962. Contract W-31-109-eng-38. 39p.

The design of high-performance natural-circulation boiling systems requires that the behavior of the systems be characterized under transient conditions. In order to accomplish this, the time- and space-dependent continuity, energy, and momentum equations for a natural-circulation system are written. This publication presents a technique for solving the equations of a natural-circulation system. The solutions are compared with experimental results at various pressures with two geometries in boiling water systems. The solutions meet the established criteria. The analog model is useful for predicting the behavior of two-phase natural-circulation systems during transients. The model accurately predicts the point at which such systems exhibit oscillatory behavior. The results were found to be sensitive to the vapor-liquid velocity ratio (slip ratio) used in the computation. The velocity ratio correlation used in the model is presented. All computations, circuits, and operating information necessary to duplicate the experiment are given. (auth)

14446 (ANL-6660) THE AXISYMMETRIC FREE-CONVECTION HEAT TRANSFER ALONG A VERTICAL THIN CYLINDER WITH CONSTANT SURFACE TEMPERATURE. R. Viskanta (Argonne National Lab., Ill.). Jan. 1963. Contract W-31-109-eng-38. 26p.

Laminar free-convection flow produced by a heated, vertical, circular cylinder for which the temperature at the outer surface of the cylinder is assumed to be uniform is analyzed. The solution of the boundary-layer equations was obtained by the perturbation method of Sparrow and Gregg, which is valid only for small values of the axial distance parameter ξ; and the integral method of Hama et al., for large values of the parameter ξ. Heat-transfer results were calculated for Prandtl numbers (Pr) of 100, 10, 2, 1, 0.72, 0.1, 0.03, 0.02, and 0.01. It was found that the Nusselt numbers (Nu) for the cylinder were higher than those for the flat plate, and this difference increased as Pr decreased. It was also found that the perturbation method of solution of the free-convection boundary-layer equations becomes useless for small values of Pr because of the slow convergence of the series. The results obtained by the integral method were in good agreement with those calculated by the perturbation method for $Pr \approx 1$ and $0.1 < \xi < 1$ only; they deviated considerably for smaller values of ξ. (auth)

14447 (BAW-1181) GAS SUSPENSION TASK II. Final Report, Nobember 1959. (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Contract AT(30-1)-2316. 139p.

Heat transfer characteristics of pure nitrogen and helium gases, investigated without turbulence promoters, satisfy the Ditus Boelter equation. The results obtained with turbulence promoters correlate well with an equation of the same type and are in agreement with published results. These results demonstrate the general suitability of the test facility for heat transfer investigations. A superficial analysis of instrument uncertainty indicates the need for a closer study of, and possibly a refinement in, instrumentation and experimental techniques. The heat transfer coefficients determined from heater sections data are uncertain by more than 20%. Heat transfer properties of graphite-helium and graphite-nitrogen gas suspensions were investigated for a range of velocities up to 550 fps for nitrogen and 450 fps for helium. The nitrogen-graphite data, involving flow around a 4-in. pitch turbulence promoter inside a 0.536-in. ID tube, display some variations between 200 and 400 ft/sec which are not currently understood; except for this restriction, the heat transfer correlation is given by

$$h = 3.0\ V\ (W_s/W_g)^{0.4} \qquad \begin{matrix} 40 < V\ \text{ft/sec} < 600 \\ 0.7 < W_s/W_g < 12 \end{matrix}$$

where h is in Btu/ft^2-hr-°F, V is in fps and W_s/W_g is in lb solid/lb gas. The maximum heat flux obtained was 300,000 Btu/ft^{2}hr at a 950°F fluid temperature, 170° ΔT, 192 fps velocity, and a solids loading of 11.0 lb solid/lb gas. Although the helium-graphite heat transfer data cannot be correlated yet, it was found that the heat transfer coefficient increases with velocity and solids loading. Heat fluxes up to 214,000 Btu/ft^{2}hr were obtained in an annular flow channel without turbulence promoters. The instrumentation for this heater unit failed completely; consequently, heat transfer coefficients could not be obtained. The annular element must be redesigned before continuing associated heat transfer studies. (auth)

14448 (CEA-2197) CONVECTION NATURELLE DANS UN CANAL VERTICAL DE SECTION RECTANGULAIRE CHAUFFE UNIFORMEMENT. (Natural Convection in a Uniformly Heated Vertical Channel with Rectangular Cross Section). Ph. Vernier (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Grenoble). 1962. 61p.

The study is experimental and theoretical. The theory is only for fully developed laminar flow. The experimental

study is made with water at low temperature. The uniform heat flux varies from 0 to 16,000 Btu/hr ft^2 and the distance between the heated plates from 0.2 to 0.48 in. The experimental correlations give the mean velocity and the temperature rise of the water, the Nusselt number versus the Rayleigh number. Experience and theory agree well for for heat fluxes sufficiently low. Using a special apparatus, the velocity and temperature profiles between the plates were measured. The profiles show that the flow is not fully developed and not a Poiseuille flow. (auth)

14449 (GEAP-3766) CRITICAL HEAT FLUX AND FLOW PATTERN CHARACTERISTICS OF HIGH PRESSURE BOILING WATER IN FORCED CONVECTION. Frank E. Tippets (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Apr. 1962. Contract AT(04-3)-189. 223p.

High-speed motion pictures of boiling water flow patterns in conditions of forced flow at 1000 psia pressure in a vertical heated rectangular channel were taken at mass velocities from 50 to 400 lbs/sec-ft^2, fluid states from 170 Btu/lb bulk enthalpy of subcooling to 0.66 bulk steam quality, and heat fluxes up to and including the critical heat flux level. An objective of the work was to make the results available for continued experimental and theoretical investigation of the critical heat flux phenomenon in forced-flow bulk-boiling systems. The results are intended to be applicable to design and development of nuclear power reactors employing high-pressure boiling water as a working fluid. Motion pictures show substantial, but not indisputable, evidence that the general arrangement of the flow, in conditions of bulk boiling, at heat fluxes near and including the critical heat flux level is characteristically a wavy turbulent liquid film, in which there is vapor formation, flowing along the channel walls with the balance of the liquid being carried as either dispersed droplets or as an emulsion with the vapor in an adjacent more rapidly and steadily moving core. (auth)

14450 (IS-587) HIGH CONDUCTIVITY FINS FOR GAS COOLED LIQUID-METAL HEAT EXCHANGERS. William F. Brown, Ray W. Fisher, and Henry M. Black (Ames Lab., Ames, Iowa). Jan. 1963. Contract W-7405-eng-82. 32p.

Nickel-plated Cu fins are brazed to the Inconel tubes of an air-cooled liquid Na heat exchanger for use to 600°C. Methods of plating annular fins for tubes are discussed and test results are presented. Brazing techniques for fin-to-tube joints are explored, and a resistance brazing process is developed. From the results of tests, it is concluded that resistance brazing is an acceptable process and electroplating is successful on fins only under very limited conditions. (auth)

14451 (NAA-SR-Memo-7524) CRITICAL HEAT FLUX OF SOME POLYPHENYL COOLANTS. H. Lurie and J. M. Robinson (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 28, 1962. Contract [AT(11-1)-Gen-8]. 25p.

The critical heat flux (CHF) of Santowax R (a polyphenyl mixture), Santowax R containing diphenyl and/or radiolytic high boilers, and OMRE reactor coolant was measured as a function of mass velocity, subcooling, and pressure under forced convection, subcooled boiling conditions. The data were correlated by equations of the form $q_c = A + B\,\Delta T_s G^{0.8}$ where q_c is the critical heat flux (Btu/hr-ft^2), ΔT_s is the subcooling (°F), G is the mass velocity (lb/sec ft^2) and A and B are empirical constants which depend on the coolant composition only. Over the range of variables covered, the critical heat flux data were correlated by: for Santowax R, $q_c = 198{,}000 + 14.5\,\Delta T_s G^{0.8}$; for a mixture of Santowax R and 27 wt % radiolytic high boilers $q_c = 353{,}000 + 16.9\,\Delta T_s G^{0.8}$; for that mixture with added diphenyl to give 2.9 to 7.4 total wt % diphenyl $q_c = 282{,}000 + 23.0\,\Delta T_s G^{0.8}$; and for OMRE, Core II coolant $q_c = 219{,}000 + 29.2\,\Delta T_s G^{0.8}$. At the same subcooling and velocity, the critical heat flux increased as a result of adding radiolytic high boilers to Santowax R. For $\Delta T_s G^{0.8} \geq 11{,}000$ the CHF of Santowax R + HB + diphenyl was greater than the CHF of Santowax R + HB, and that of OMRE coolant was higher than either. (auth)

14452 (NP-12578) CRITERIA FOR THE BREAK-UP OF THIN LIQUID LAYERS FLOWING ISOTHERMALLY OVER SOLID SURFACES. Nuclear Engineering Laboratory Memorandum Q 5. D. E. Hartley and W. Murgatroyd (London. Univ. Queen Mary Coll.). Sept. 1961. 46p.

The question of the minimum wetting rate of a liquid flowing over a solid surface was approached theoretically, based on the idea that the break-up of a liquid film is connected with the relative magnitudes of the surface tension and inertia forces in the system. Two (very similar) criteria are suggested; one is based on a force balance at the upstream stagnation point of a dry-patch, the other on the minimum total energy rate in a transversely unrestrained stream. The criteria were applied to vertical gravity flow of laminar films and to both laminar and turbulent films motivated only by shear forces at the free liquid surface. These latter examples are of special interest with regard to the burn-out in two-phase gas-liquid flows. Comparisons with experimental evidence appear promising. (auth)

14453 (PAN-343/IX) TRANSIENT TEMPERATURE DISTRIBUTION IN THE CLAD OF THE FUEL-ELEMENT. Wiesław Ciechanowicz (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). July 1962. 7p.

The solution of the partial differential equation describing thermal processes in the clad of a fuel channel is presented. This equation is solved by the assumptions that the coolant temperature is not a function of time and the conduction in the longitudinal direction is neglected. As a result, the distribution of the clad temperature with respect to time and radius is obtained. (auth)

14454 (SC-4752(RR)) A STUDY OF VELOCITY PROFILES IN THE MOMENTUM INTEGRAL METHOD WITH SLIP BOUNDARY CONDITIONS. K. J. Touryan (Sandia Corp., Albuquerque, N. Mex. and Sandia Corp. Livermore Lab., Livermore, Calif.). Feb. 1963. Contract [AT(29-1)-789]. 16p.

The Von-Karman Pohlhausen Momentum Integral method was extended to viscous flow problems with slip. The effect of the choice of velocity profiles and surface boundary conditions on displacement thickness are studied and some explanations presented. (auth)

14455 (TID-17718) HEAT TRANSFER TO A GAS AT HIGH TEMPERATURE. Technical Report No. 247-1. Monty E. Davenport, Patrick M. Magee, and George Leppert (Stanford Univ., Calif. Nuclear Technology Lab.). May 1960. Contract AT(04-3)-247. 77p.

Local and average convective heat transfer coefficients are measured for N_2, He, and CO_2 flowing turbulently through electrically heated, smooth, round tubes. Data are given for Reynolds numbers of 3,200 and 48,000, surface temperatures of 300 to 2300°F, gas temperatures below 1850°F, and heat fluxes up to 172,000 Btu/hr/ft^2. The Nusselt, Reynolds, and Prandtl numbers for the flows considered are related empirically, for both the local and average heat transfer. The accuracy of the empirical equations derived is estimated as 12%. (T.F.H.)

14456 (TID-17889) DRAG AND HEAT TRANSFER OF FLUID SPHEROIDS IN STEADY MOTION. Interim Report. S. Winnikow (Illinois. Univ., Urbana). Jan. 1963. Contract AT(11-1)-1069. 117p.

Results of an investigation concerning the mechanics of heat transfer in two-phase flow are presented. Data and information are included on droplet mechanics, heat transfer to fluid spheroids, experimental procedures, equipment used, and results obtained. A comparison of experimental results with theoretical values is also included. (J.R.D.)

14457 (TID-18006) BASIC EXPERIMENTAL STUDIES OF BOILING FLUID FLOW AND HEAT TRANSFER AT ELEVATED PRESSURES. Monthly Progress Report, January 1963. Bruce Matzner (Columbia Univ., New York. Engineering Research Labs.). Jan. 31, 1963. Contract AT(30-3)-187. 12p. (MPR-XIII-1-63)

Analysis of the previously reported burnout data obtained from three tubular test sections indicated that the instrumented burnout signals that were observed were generated by temperature excursions in the axial channel for the two solid tubular test sections (where separate channel burnout detection was not possible) as well as for the composite tubular test section (where both channels were provided with burnout detection). These revised findings are believed to be associated with a previously unobserved diameter effect on burnout heat flux in large diameter tubes (>0.5 in.) at high pressure. Plans are now being made to investigate separately the axial channel of the composite tubular test section to determine whether this reduction in burnout heat flux was a diameter effect or was caused by hydraulic interaction between the axial and annular channels. Fabrication of a 19-rod test section with a 6 ft heated length continued on schedule with test operation due to begin the second week in February. An addition is also being made to the existing pressure tap manifold, which will increase from three to seven, the number of individual differential pressure measurements that can be taken along the length of a test section. (auth)

14458 (TRG-Report-245) THE EFFECT OF VARIATIONS IN END-FITTING DESIGN ON END-CAP TEMPERATURES. L. R. T. Gardner (United Kingdom Atomic Energy Authority. Reactor Group, Springfields, Lancs, England). Nov. 8, 1962. 28p.

A method of predicting can surface and end-fitting temperatures by the use of a one-dimensional model is described. The method is first used to predict temperature distributions for a standard problem. Good agreement is reached with the exact solutions found by analogue and digital computer methods. The model is then compared with a typical three-dimensional relaxation solution and a typical three-dimensional analogue solution of the problem and the extent of agreement is discussed and found satisfactory. It is shown that end-cap temperatures are relatively insensitive to small variations in the conductivity of the ceramic and that for many practical cases the insulator may be assumed perfect. The model is then used to analyse the end-fitting temperatures for a range of values of can/gas heat-transfer coefficient on the unfinned portion of can. The results are applied to a Parsons experiment in order to determine a realistic value of end-fitting heat-transfer coefficient. The coefficient obtained from the Parsons data is then used to assess how temperatures in the can and end fitting may be changed by fin cropping, variation of insulation disc thickness, length of end fitting and can wall thickness. The method has been programmed for a digital computer and should be of assistance in the design study stage of developing a fuel element. The final assessment of a fuel element will always depend on a complete three-dimensional solution of the problem. (auth)

14459 THE CHARACTERISTIC FORM OF THE EQUATIONS OF ONE-DIMENSIONAL MAGNETOHYDRODYNAMIC FLOW WITH OBLIQUE MAGNETIC FIELD. Roy M. Gundersen (Illinois Inst. of Tech., Chicago). AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 219-20(Jan. 1963).

A derivation is presented for the characteristic form of the equations governing the one-dimensional unsteady flow of an ideal inviscid, conducting, compressible fluid in an oblique magnetic field. (D.L.C.)

14460 A CLASS OF LINEAR MAGNETOHYDRODYNAMIC FLOWS. M. R. El-Saden (North Carolina State Coll., Raleigh). AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 236-8(Jan. 1963).

The continuity, momentum, Maxwell, current conservation, and Ohm's Law equations are given for the steady laminar flow of a conducting fluid of constant properties. Equations are derived which involve V (velocity vector), B (magnetic flux density vector), and P (pressure) only. Two cases are discussed in which the nonlinear differential terms become linear. (D.L.C.)

14461 A LOOP FOR THE INVESTIGATION OF HEAT TRANSFER AND FOR THE DETERMINATION OF THE OPERATING CONDITIONS WITH ORGANIC REACTOR COOLANTS. H. Abel-Larsen (Atomenergiekommission, Risø, Denmark). Atomkernenergie, 7: 403-4(Nov. 1962). (In German)

An out-pile loop for examination of heat-transfer characteristics of organic coolants is described. The coolant channel is an annulus with equivalent diameter of 4 mm. The heated test tube is 12 mm in diameter and 500 mm long. The maximum heat flux is 200 watt/cm^2. It is possible to insert other test sections. The loop is under construction. (auth)

14462 HEAT TRANSFER IN RING COLUMNS WITH FORCED CONVECTION AND LOCAL BOILING. H. Brauer (Forschungsinstitut der Mannesmann A. G., Ger.). Atomkernenergie, 8: 1-9(Jan. 1963). (In German)

Thorough knowledge of heat transfer under conditions of evaporation is required in order to build a nuclear reactor as well as a high-power heat exchanger. For this purpose, heat-exchange and pressure drop measurements were made on a horizontal ring channel with a stream of water passing through it. The sheathed tube had a diameter of 19.4 mm, whereas the diameters of the electrically heated nuclear tubes were 4, 8, 10, 12, 14, and 16. The diameter proportion thus changed from about 0.2 to 0.83. During the heat transfer measurements, the temperature of the nuclear tube, starting at about 40°C, was increased step by step to about 220°C. The temperature of the water entering the ring channel was about 13°C and the pressure in the channel 3.2 atm. As long as no steam bubbles formed on the tube wall, the measurement results could be easily reproduced through the Hausen equation. When the temperature of the tube wall exceeded the boiling point of the water which was at 135°C, by 20 to 30°C, bubble evaporation set in due to which the heat transfer was considerably increased. The wall temperature was increased to such an extent that a steam film formed on the nuclear tube which led to the burning through of the latter. Transfer with film evaporation has a Nusselt number 20 times greater than heat transfer without evaporation. A diagram was drawn up for every investigated ring gap with the aid of which the heat transfer for the different relationships can be calculated. In addition to the measurements of the heat transfer, pressure drop

measurements were also carried out. It was seen that the laws of resistance which apply to the singlephase current, can still be used to calculate the pressure drop when boiling bubbles are present on the heating surface. (auth)

14463 A SURVEY OF BOILING BURN-OUT. W. R. Gambill (Oak Ridge National Lab., Tenn.). Brit. Chem. Eng., 8: 93-8(Feb. 1963).

A broad survey of boiling burn-out is presented, intended for those who are specialists in other areas. Included are sections dealing with critical-flux regimes, sources of some 1400 experimental determinations of burn-out flux, discussion of variables involved, and recommendations regarding correlation and prediction. Consideration is given to burn-out under conditions of saturated and subcooled pool boiling, confined natural convection, and subcooled and bulk-boiling forced convection. (auth)

14464 THE EFFECTS OF MAGNETIC FIELDS AND ROTATION ON HEAT TRANSFER BY CONVECTION. Y. Nakagawa (Institut d'Astrophysique, Paris). Bull. Soc. Roy. Sic. Liege, 31: 685-95(1962). (In English)

A brief summary of the theoretical and experimental studies on the joint effect of a magnetic field and rotation on the macroscopic motions of a fluid is presented. The physical action of the field and rotation on the behavior of the fluid is stressed. (J.S.R.)

14465 SOME CONSIDERATIONS ON THE HYDRAULICS OF BIPHASE FLUIDS. M. Silvestri (CISE, Milan). Energia Nucl. (Milan), 9: 557-63(Oct. 1962). (In Italian)

Biphase fluids have more than a dozen types of flow in contrast to monophase fluids for which there are only two types of flow-laminar and turbulent. Special attention was given by the CISE to dispersed annular flow, which can be defined as a flow characterized by a high linear velocity and by a distribution of the liquid phase in the form of droplets in the gaseous phase and of a very thin adherent film on the walls of the flow channel. The thickness of the liquid film was determined as a function of different physical variables (dynamic variables and physical properties of the two phases in movement). The distribution of the liquid phase in the channel core was also measured. Experiments with the heat flux confirm the hypothesis that the liquid film on the heated walls play an important role in the determination of the mechanism of heat exchange. (tr-auth)

14466 A NEW METHOD OF EVALUATING STEAM VOLUME FRACTIONS IN BOILING SYSTEMS. Haruo Nishino (Nippon Atomic Industrial Group Co., Ltd., Japan) and Yasaburo Yamazaki. Nippon Genshiryoku Gakkaishi, 5: 39-46(Jan. 1963).

A new parameter is introduced to predict the steam volume fractions and the slip ratios of upward-vertical steam-water mixtures in boiling systems. The parameter K is defined as the ratio of the velocity difference between steam and water to the superficial steam velocity. The K is correlated by use of the data of ANL. The predicted liquid volume fractions $(1-\alpha)$ which are obtained from both the equation defining K and mass balance equation agree with error of $\pm 10\%$ with the measured liquid volume fractions. If the inlet liquid velocity as a parameter is disregarded, K = 1 can be used for the ranges, 1 atm to critical in pressure and 0 to 1 in quality. (auth)

14467 LIQUID INSTABILITY AND ENERGY TRANSFORMATION NEAR A MAGNETIC NEUTRAL LINE: A SOLUBLE NONLINEAR HYDROMAGNETIC PROBLEM. S. Chapman (Univ. of Alaska, College; Univ. of Colorado, Boulder, and Univ. of Michigan, Ann Arbor) and P. C. Kendall. Proc. Roy. Soc. (London), Ser. A, 271: 435-48 (Feb. 12, 1963).

Hydromagnetic flow of a conducting fluid has a special character near a magnetic neutral line. This is investigated with reference to the two-dimensional motion of a cylinder of perfectly conducting liquid in a permanent magnetic field, of which the axis of the cylinder is a neutral line. Electric current is induced in the liquid by its irrotational motion in the magnetic field. The liquid is uniform, incompressible and frictionless. The surface is elliptically cylindrical, infinitely long, free and in vacuo. The motion is governed by the force exerted on the electric current by the magnetic field, permanent and induced. The stream lines are constant rectangular hyperbolas, in planes normal to the cylinder axis. The permanent magnetic field lines are orthogonal rectangular hyperbolas. The cylinder axis is a stagnation line and a magnetic neutral line. If the liquid is initially at rest, with circular cross-section, and no electric current, its state is unstable. A small motion imparted to it, of the kind indicated, will grow indefinitely, magnetic energy being converted into kinetic energy. The initial motion, however, need not be small. This non-linear hydromagnetic problem is completely soluble. The initial conditions may be chosen in more than one way. The bearing of the solution on the theories of solar flares and the aurora is briefly considered. (auth)

14468 RASCHETY TEMPERATURNYKH NAPRYAZHENII V YADERNYKH REAKTORAKH. (Calculations of Temperature Gradient in Nuclear Reactors). I. I. Gol'denblat and N. A. Nikolaenko. Moscow, Gosatomizdat, 1962. 159p.

The basic equations for thermal elasticity, plasticity, and creep are given. An analysis is made of mechanical properties of materials used in reactor construction and the methods used in thermal stress and temperature distribution analysis are evaluated. (R.V.J.)

Materials Testing

14469 (HW-SA-1821) AUTOMATIC CLADDING THICKNESS AND BONDING TESTER FOR REACTOR FUEL ELEMENTS. D. O. Hunter (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 4, 1959. Contract AT(45-1)-1350. 33p.

Nondestructive tests applied to fuel elements to determine jacket-core bonding and penetration of the Al–Si bonding material into the jacket are described. The tests and equipment are discussed with the aid of slides, reproductions of which are included. (J.R.D.)

14470 (IA-750) RADIOGRAPHIC TESTING OF WELDS FOR NUCLEAR FUEL ELEMENT CLADDING. Y. Goldstein and A. Bar-Or (Israel. Atomic Energy Establishment Rehovoth). Sept. 1962. 13p.

Defects, due mainly to insufficient penetration of the weld or to defects in the weld region, may appear while welding the aluminium cap onto the container that serves as cladding for nuclear fuel elements. Insufficient penetration of the weld may cause defects of up to 0.1 mm; defects in the weld region may be about 0.005 m. Detection of the two defects by a non-destructive method is described. The method is based on radiography directed tangentially towards the cap. To provide an uniform thickness, an additional device, made of the same material as the cap, is employed. This device also contains the film. Radiographs and micrographs gave good agreement. (auth)

GEOLOGY, MINERALOGY, AND METEOROLOGY

14471 (CLOR-12) STRONTIUM-90 IN SOIL, POLAND, 1960. R. Szepke and D. Grzybowska (Poland. Biuro Pelnomocnika Rzadu do Spraw Wykorzystania Energii Jadrowej. Centralne Laboratorium Ochrony Radiologicznej, Warsaw). 1962.

Measurements of Sr-90 content in 37 soil samples collected in Poland during 1960 are presented. Data concerning the Sr deposition in soil are tabulated. Correlation between the amount of Sr-90 deposited in soil and calcium content, soil acidity, and soil type are discussed. (auth)

14472 (HW-58312(Rev.)) COLUMBIA RIVER FLOW-TIME CALCULATIONS. J. K. Soldat (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 1, 1962. Contract AT(45-1)-1350. 12p.

An appraisal of available data on flow times in the Columbia River between the reactor areas and Pasco was made to permit extrapolation of the flow-time curves to lower river flow rates. Comparisons were made between data collected by the U. S. Corps of Engineers and environmental monitoring data and with the previously developed equation for flow times. New equations were developed to fit curves over the range (4 to 40) $\times 10^4$CFS. (H.G.G.)

14473 (HW-SA-2798) APPLICATION OF RADIOACTIVE TRACERS IN SCIENTIFIC GROUND WATER HYDROLOGY. R. W. Nelson and A. E. Reisenauer (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 18, 1962. Contract AT(45-1)-1350. 41p. (SM-38/17)

Radioactive tracers may serve as a valuable tool in the analysis of ground water hydrology. An area of major contribution is in the determination of the more fundamental properties of porous flow systems, such as: porosity distributions, stream functions, and components of the permeability tensor. However, before the full capability of radioisotopes can be utilized in studying these fundamental properties, an understanding and description of hydrodynamic dispersion in porous media are needed. The importance of dispersion and flow system geometry in the analysis of tracer results is illustrated through solution of a particular system. Equations describing three-dimensional flow through the soil from a pond are solved. A linear approximate analysis of dispersion is superimposed to provide a method for interpreting tracer results. Some examples of possible misinterpretations by not separating the several independent causations are illustrated. Suggestions are given to assure representative sampling techniques for radioactive tracers. (auth)

14474 (HW-SA-2890) SOME INFLUENCES OF SOILS AND WATER TABLE DEPTHS ON SEEPAGE FROM LINED AND UNLINED CANALS. A. E. Reisenauer and R. W. Nelson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 5, 1963. Contract AT(45-1)-1350. 20p.

A computer program capable of solving problems relating to multidimensional, partially-saturated flow in heterogeneous soils has been briefly described and used to examine rates of seepage loss from canals. The losses based on a partially-saturated flow analysis were found to be considerably less than those predicted by the traditional saturated analysis. For the cases analyzed, the saturated analysis overestimated the seepage rates by as much as 32 times. Depth to the water table was shown to have an appreciable effect on seepage rate. Under partially saturated flow conditions the seepage rate was found to decrease significantly with increased water table depth. (auth)

14475 (NP-12255) USE OF FOCAL DEPTH DETERMINATIONS IN DISTINGUISHING UNDERGROUND BLASTS FROM EARTHQUAKES. Eugene Herrin and James Taggart (Southern Methodist Univ., Dallas, Seismological Observatory). Nov. 1962. 55p.

Regional variations in Pn velocities from nuclear explosions, which must be considered in locating epicenters and thus the focal depth, are discussed. Results of experiments in the United States and studies of Russian and Japanese literature are reported. Construction of regional Pn velocity maps is described. A computer technique for the location of epicenters is summarized. The importance of time corrections for stations is emphasized. Recommendations for determination of depth of focus are outlined. A broad-band seismograph is described. Field studies are summarized. (M.C.G.)

14476 (NP-12594) COLONA EARTHQUAKE (COLORADO). Long Range Seismic Measurements [of] VELA UNIFORM Project 8.4. (United ElectroDynamics, Inc., Alexandria, Va.). Feb. 5, 1962. Contract AF33(657)-7427. 21p.

An analysis of the long range seismic (LRSM) film of the Colona Earthquake of Feb. 5, 1962, from 36 mobile field teams is presented. Tables summarizing the measurements of the principal phases of this earthquake, including maximum amplitudes, arrival times and travel-time residuals, are included. (H.G.G.)

14477 (NRL-5869) FISSION PRODUCT RADIOACTIVITY IN THE AIR ALONG THE 80TH MERIDIAN (WEST) DURING 1961. L. B. Lockhart, Jr., R. L. Patterson, Jr., A. W. Saunders, Jr., and R. W. Black (Naval Research Lab., Washington, D. C.). Jan. 18, 1963. 14p. (AD-297345)

The concentrations of fission product radioactivity in the atmosphere continued the trends exhibited since the beginning of the moratorium on nuclear testing; namely, a clearly defined seasonal variation in activity at sites in the northern hemisphere, a less obvious one in the southern hemisphere. A tendency toward equilibration of the activity concentrations in the two hemispheres, through both a slowly decreasing concentration of fission products in the atmosphere north of the equator and an increase south of the equator was exhibited. Prior to reinitiation of the Soviet nuclear testing program in Sept. 1961, the natural radioisotope lead-210 had become a significant contributor to the total long-lived β activity in the atmosphere. After September 1961, the fission product radioactivity in the northern hemisphere increased a hundredfold; a small but measurable transfer of activity to the southern hemisphere occurred during the last months of 1961. (auth)

14478 (NSEC-62) METEOROLOGICAL EVALUATION OF RADIOACTIVE FALLOUT. Annual Report. Paul Kruger and Charles L. Hosler (Nuclear Science and Engineering Corp., Pittsburgh). Mar. 31, 1962. Contract AT(30-1)-2588. 47p.

Analysis was made of seven spring and summer rainstorms resulting from convective activity collected at State College, Pennsylvania. The data indicate that the ground-level Sr^{90} concentration in the precipitation is dependent upon the extent of the vertical development of the

clouds from which the precipitation originates and the distance of these clouds from the jet stream. These data are contrasted to the data obtained for precipitation resulting from large-scale uplift where the generating level is essentially constant, and the ground-level Sr^{90} concentration has been shown to be dependent upon the descent experience of the precipitation in falling from the cloud to the ground. (auth)

14479 (NSEC-80) ANALYSIS AND EVALUATION OF FALLOUT RADIOACTIVITY IN PITTSBURGH PRECIPITATION. Status Report No. 1, July 1–October 31, 1962. R. C. Koch, L. G. Davis, and C. R. Wilson (Nuclear Science and Engineering Corp., Pittsburgh). Nov. 15, 1962. Contract AT(30-1)-3072. 21p.

Experimental measurements of the deposition rates of the respective radionuclides and their concentrations in Pittsburgh precipitation, and the correlation of the experimental data for individual precipitation with general meteorological parameters are presented. Statistical correlations that may exist between the radiochemistry and meteorology data for these events may be applicable to a better understanding of the phenomena effective in the transport of nuclear debris from the stratosphere to the ground. (H.G.G.)

14480 (RM-3386-PR) NOTES ON DEBRIS-AIR-MAGNETIC INTERACTION. Conrad L. Longmire (RAND Corp., Santa Monica, Calif.). Jan. 1963. Contract AF49 (638)-700. 11p. (AD-296597)

A set of hydrodynamic-like differential equations is derived for the motion of debris and air ions as they interact through the magnetic field. Although these equations are not solved in detail, several conclusions can be deduced: At early times, the fraction of the debris mixed with the magnetic field (and hence the intensity of the β-ray aurora) is proportional to the cube of the time; the outer debris ions are simply bent by the normal earth's magnetic field; air ions are picked up essentially when the debris has moved one air-ion Larmor radius. (auth)

14481 (TID-17518) METEOROLOGICAL EVALUATION OF RADIOACTIVE FALLOUT. Semi-Annual Report. Paul Kruger, Albert Miller, and Charles L. Hosler (Hazelton-Nuclear Science Corp., Palo Alto, Calif.). Oct. 31, 1962. Contract AT(04-3)-457. 60p. (HNS-10)

Analyses were made of four winter storms at State College, Pennsylvania, and one extensive coastal storm at Santa Barbara, California. Additional investigation of large-scale uplift conditions from four winter storms confirmed the earlier observations of the dependence of Sr^{90} concentrations in precipitation upon the descent experience of the precipitation in falling from the cloud to the ground. Time cross sections of the storms enabled a more detailed analysis of the storms to be made. The effects upon Sr^{90} concentration in precipitation formed by an ice or all-water process and in precipitation originating in frontal or trough zones were examined. The coastal storm of February 7, 1962, at Santa Barbara, California, was almost completely analyzed. Four significant changes in the Sr^{90} concentration occurred at all three elevations during the period of collection. These changes are being evaluated in relation to the extensive meteorological data accumulated for this storm. Little orographic activity was seen in the coastal storms occurring in California during the winter 1961–62. (auth)

14482 (TID-18002) INVESTIGATIONS IN ISOTOPIC GEOCHEMISTRY. Annual Progress Report No. 8. J. Laurence Kulp, E. J. Catanzaro, G. Clark, J. Engels, G. P. Erickson, F. P. Fanale, R. Kologrivov, F. McDowell, I. G. Swainbank, and J. M. Wampler (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory. Geochemistry Lab.). Jan. 31, 1963. Includes Appendices A-M. Contract AT(30-1)-1669. 359p.

Progress in isotopic geochemistry is reported. Topics covered include: isotopic study of lead in sedimentary pyrite, discordant U-Pb systems in zircon from ancient basement rocks, base exchange studies in micas relating to K-Ar and Rb-Sr ages, concordance of Rb-Sr and K-Ar ages and the half life of Rb^{87}, evolution of the Hawaiian Island Range, geochronology of Martinique, age of the Stillwater complex, isotopic age study, search for Precambrian in southern Mexico, ancient core of the African continent, Fairbanks area of Alaska, Baranof Island in Alaska, the alleged 850-million-year metamorphism in the N. J.-N. Y. highlands, geochronological study in the northern cascades, helium in magnetite and sulfide minerals, and age of the Kansas basement. (M.C.G.)

14483 CONTRIBUTION TO THE RADIO-CHRONOLOGY OF SOME NATURAL DEPOSITS. G. Atanasiu (Univ. of Bucharest). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 13: 411-26(1962). (In Rumanian)

The results obtained for the dating of some natural deposits several thousand years old are reported. It was shown that some deposits of mineral waters contain only Ra and its descendants without any U which gives birth to the Ra. The U remains at some depth, fixed by physicochemical processes. By determining the Ra of recent deposits of a similar source of mineral water and by determining the Ra of old deposits of the same source, the age of these deposits can be calculated. For example, for old deposits of chalky bedrock of the sources of Singeroz mineral water, an age of approximately 7900 years was found. Deeper beds of the same deposits have a greater age. Another method studied is based on the disintegration of C^{14}. It is shown how the radiocarbon of the atmosphere passes into stalactites and stalagmites of a cave where it produces a weak β activity of these concretions and, at the same time, an ionization of the air of the caves which contain chalky concretions during their formation. This method permits the dating of the cave concretions and an evaluation of the ionization of the air. It was found that the formation of a gram-mole of concretion produces in the air of the caves a quantity of 3×10^5 ions/min approximately. (tr-auth)

14484 RADIOACTIVE AIR POLLUTION. T. Kopcewicz. Acta Geophys. Polon., 10: 299-334(1962).

The distribution and character of radioactive air pollutants over Central Europe were investigated on the basis of upper and ground-level synoptic charts of the Northern Hemisphere. Analysis of the concentrations of radioactive aerosol indicate that air contamination may be either transient (one to several days) or prolonged (several days or more). The meteorological conditions leading to either type of contamination are discussed under the assumption that air pollution is caused by radioactive particles moving from the cold mass of the lower stratosphere to the warm mass of the upper troposphere through gaps occurring in cyclones along cold fronts. A correlation was observed between the periodicity or rhythmicity of the time variations of some meteorological factors, air temperature and pressure, and that of radioactive ground pollution. Annual variation in contamination of the lower troposphere by stratospheric radioactive aerosol in the zone of the westerlies, noted in the annual course of air, precipitation, and fallout contamination, is caused by two factors: annual variation in the concentration of radioactive particles in the lower tropo-

sphere of the middle latitudes; and annual variation in the intensity of aerosol exchange between the stratosphere and troposphere in the middle latitudes. (OTS)

14485 NATURAL RADIOACTIVITIES AROUND OUR LABORATORY. Akira Okawachi, Tadao Matsunami, Kazuko Yoshikawa, Takashi Matsumura, Toshio Ishiyama, Tetsuo Mamuro, and Toshio Azuma. Ann. Rept. Radiation Center Osaka Prefect., 1: 1-9(1960). (In English)

The natural background radioactivities in atmospheric dusts, rain water, surface water and weeds around the Osaka Prefecture Laboratory were measured during 1960. High counting rates of >350 cpm/l were obtained from rain water samples on March 1, 1960. However, decay curves and gamma spectra reveal that this rain water contained nuclear debris of the French nuclear test explosion in the Sahara Desert on Feb. 13, 1960. Continuous sampling of radioactive dusts reveals that the amount of radioactive fallout has been decreasing since June 1960. The experimental results from surface water and weeds reveal that the main source of radioactivity in the vicinity was natural potassium-40. (H.G.G.)

14486 OBSERVATIONS FROM SOME GNOME SEISMOGRAMS. Dorris M. Hankins (Sandia Corp., Albuquerque, N. Mex.). Bull. Seismol. Soc. Am., 52: 1075-7(Dec. 1962). (TID-16194; SCDC-2731; SCR-579)

Comparison of GNOME seismic signals at four stations with seismograms from an explosion in tuff show relatively more energy in the P_g phase than would be predicted from first phase amplitudes. Dispression curve for a surface layer Rayleigh mode is given. (auth)

14487 PHOTOCHEMICAL PROCESSES IN THE IONOSPHERE INDUCED BY SOLAR PROTON BOMBARDMENT. Luise Herzberg (Defence Research Telecommunications Establishment, Ottawa). Bull. Soc. Chim. Belges, 71: 688-704(Nov.-Dec. 1962). (In English)

Certain ionospheric disturbances produced mainly by solar protons show characteristic diurnal variations which indicate that photochemical processes play a role in these events. For the interpretation of the observed effects, several mechanisms, involving various negative ions as well as nitric oxide, have been suggested. These mechanisms and their limitations are discussed. (auth)

14488 DISTRIBUTION OF URANIUM BETWEEN THE ORGANIC AND MINERAL PARTS OF URANIFEROUS SHALES. Jean-Armand Martin (Faculte de Pharmacie, Nancy and Centre d'Études Nucléaires, Fontenay-aux-Roses, France). Bull. Soc. Chim. France, No. 10, 1979-80 (Oct. 1962). (In French)

The uranium of Saint Hippolyte (Bas-Rhin) shales, indiscernible mineralogically, can be fixed by adsorbants of the mineral part or of the organic part of the shale. With the aid of two fractionation methods borrowed from carbon analysis, it was shown that the uranium is principally adsorbed by the mineral constituents of the shale in the sample studied. (tr-auth)

14489 THE ARTIFICIAL RADIOACTIVITY OF THE AIR AND OF PRECIPITATIONS. Hubert Garrigue (Observatoire du Puy de Dome, Orcines, France). Compt. Rend., 256: 739-41(Jan. 14, 1963). (In French)

A series of aerial measurements for a year and an estimation of the equivalence value between the air samplings and the precipitation samplings were obtained, and the results are tabulated. (tr-auth)

14490 Sr^{90} CONCENTRATION IN PRECIPITATION RESULTING FROM LARGE-SCALE UPLIFT. Leonard P. Salter (Nuclear Science and Engineering Corp., Pittsburgh), Paul Kruger, and Charles L. Hosler. J. Appl. Meteorol., 1: 357-65(Sept. 1962).

Analysis was made of 3 winter rainstorms, resulting from large-scale uplift, in which the generating level and the precipitation mechanism were essentially constant. The data show that the ground-level Sr^{90} concentration in the precipitation is determined by the descent experience of the precipitation in falling from the generating cloud to the ground. The descent experience can be expressed in terms of the height of the ceiling, which is an index of the humidity profile and depth of the lower layers of air. These parameters affect the rate of evaporation or growth of the precipitation elements and, thus, the final concentration of Sr^{90} reaching the ground. (Public Health Eng. Abstr., 42: No. 12, 1962)

14491 MEASUREMENTS OF LONG-LIVED RADIOACTIVITY IN THE ATMOSPHERE. W. Marquardt (Meteorologischen Observatorium Wahnsdorf, Radebeul, Ger.). Kernenergie, 5: 782-7(Oct.-Nov. 1962). (In German)

After a brief description of the measurement methods and the calibration of the measurement network for monitoring of the atmospheric radioactivity in the DDR, a survey on the distributions of long-lived radioactive aerosols in the atmosphere was given. On the basis of $2\frac{1}{2}$-year mean values, the effect of the vertical exchange was discussed. The results of the daily filter measurements of all stations from September to December 1961 were given graphically. Striking parallelities were indicated. The circulation of radioactive clouds is indicated in a variance of the concentrations with the geographic latitudes. Isotopic investigations were carried out by energy determinations of fresh and old fission products. An autoradiographic method for the optimum determination of hot particles was proposed. For the radioactive fallout, data were given on the contribution of dry and wet fallout. General rains brought, on an average, a higher specific activity than showers. A quarterly compilation of the radioactive fallout of 1961 is presented. (tr-auth)

14492 THE DETERMINATION OF THE ARTIFICIAL RADIOACTIVITY OF ATMOSPHERIC AEROSOLS. A. Cigna (Comitato Nazionale Energia Nucleare, Rome). Minerva Nucl., 6: 297-301(Oct. 1962). (In Italian)

The features of the main types of filter used for measuring the artificial radioactivity of atmospheric aerosols are discussed and the important aspects of this method of measurement are examined, these being: daily volume of air to be filtered, decay coefficient, and autoradiographic tests. Certain data are provided regarding the timing of nuclear explosions. (auth)

14493 URANIUM AND THORIUM ABUNDANCES IN POSSIBLE UPPER MANTLE MATERIALS. J. F. Lovering and J. W. Morgan (Australian National Univ., Canberra). Nature, 197: 138-40(Jan. 12, 1963).

Eclogites from the continental upper mantle have very similar U (range 0.04–0.07 ppm) and Th(range 0.15–0.29 ppm) abundances with mean values of 0.052 ppm U and 0.22 ppm Th. The Th/U ratios for the continental upper mantle eclogites range from 3.5 to 5.8 with a mean value of 4.2. Oceanic eclogites indicate a Th/U ratio of 2.4. The crustal eclogites have a U content range of 0.018–0.24 ppm, a Th range of 0.015–0.60 ppm, and a Th/U ratio between 0.6 and 4.8. (H.G.G.)

14494 CAESIUM-137 IN DRIED MILK PRODUCTS IN RELATION TO PHYTOCLIMATIC ZONES. W. H. Rickard,

A. D. Wiggins, and J. K. Fremstad (General Electric Co., Richland, Wash.). Nature, 197: 197-8(Jan. 12, 1963).

Total precipitation is regarded as important in depositing Cs-137 over landscapes and the amounts deposited are related to the amount of precipitation; moist regions receive more Cs-137 than regions of less moisture. The higher average Cs-137 content of dried milk products produced in the moist forest zone appears related to the greater precipitation in this zone in contrast to the grassland and sagebrush zones. Seasonal precipitation can greatly influence the amounts of Cs-137 deposited on foliar surfaces. (H.G.G.)

14495 LOW CONCENTRATION OF TRITIUM IN IRON METEORITES. Murry A. Tamers (Univ. of Texas, Austin). Nature, 197: 276-7(Jan. 19, 1963).

A new theory for the explanation of the low concentration of T in Fe meteorites is discussed. It suggests that T dissolved in Fe, possibly denuded of its electrons and held in a strong magnetic field, no longer decays with its ordinary 12-year half life, but much more rapidly, perhaps with a half life of only several days. An experiment to test this proposition is proposed for further study. (H.G.G.)

14496 MEASUREMENT OF IONOSPHERIC ELECTRON CONTENT REGARDLESS OF APPROXIMATIONS. P. R. Arendt (U. S. Army Electronics Research and Development Lab., Fort Monmouth, N. J.). Nature, 197: 579-80(Feb. 9, 1963).

A method is described for obtaining new data on the integrated electron density along paths in the ionosphere. Approximation assumptions are used for the isotropic and static medium, validity of reciprocity theorem, and equal propagation paths for the various frequencies used simultaneously but the method is free of additional assumptions about path length, path curvature, altitude, ionospheric stratification, and geomagnetic field. Representative equations are presented. (C.H.)

14497 MOTION OF CURRENT SYSTEMS IN THE IONOSPHERE. J. A. Lawrie (Magnetic Survey, Christchurch, N. Z.) and A. T. Price. Nature, 197: 581-2(Feb. 9, 1963).

Comparative investigations were made of magnetograms from 9 locations for the spatial distribution of rapid geomagnetic fluctuations in the ionosphere during a typical magnetic storm. Evidence was seen of a general motion eastward of the pattern of disturbance. Vector diagrams of the horozontal field deviations at specified epoch were plotted on charts showing geographic positions of the stations. Examination of data suggested the existence of a pulsating current circulation travelling eastwards. (C.H.)

14498 METEOROLOGICAL CONDITIONS DEPENDENCE OF RADON CONCENTRATION IN THE AIR ABOVE THE ATLANTIC OCEAN. J. Fontan (Nuclear Physics Centre, Toulouse), D. Blanc, A. Bouville, and J. Lacaze. Nature, 197: 583-4(Feb. 9, 1963).

Concentration of radon in the air at a point above the Atlantic Ocean was measured during May 28 to June 28, 1962. Attempts are described to relate the values of natural radioactivity to meteorological conditions. (C.H.)

14499 URANIUM CONTENT IN RECENT SEDIMENTS IN JAPAN. Eikichi Ideno and Toshiko Sugimura (Univ.). Nippon Genshiryoku Gakkaishi, 5: 46-8(Jan. 1963).

Uranium in some recent sediments in Japan was determined by a colorimetric method. The average value for uranium is 2.5 ppm in normal regions. In reductive regions, uranium values are 8.7 to 18.1 ppm. These values are lower than a hundredth of those for the Ningyōtōge ore. (auth)

14500 GEOLOGY AND NUCLEAR PHENOMENA. II. NUCLEAR PHENOMENA IN GEOLOGY (2ND PART). THE RADIOACTIVITY OF THE GLOBE. Pierre Comte. Nucleus (Paris), No. 6, 459-71(Nov.-Dec. 1962). (In French)

The natural radioactivity of the earth, spontaneous fission, various secondary reactions, and the consequences of these phenomena are examined successively from the viewpoint of the evolution of the earth. The data reviewed permits an examination of the distribution of the natural radioactive elements in the earth's strata and the distribution of the caloric flux. The question of evolution with respect to this last problem is then discussed. (J.S.R.)

14501 UPPER ATMOSPHERIC DISTURBANCES DUE TO HIGH ALTITUDE NUCLEAR EXPLOSIONS. Tatsuzo Obayashi (Kyoto Univ.). Planetary Space Sci., 10: 47-63 (1963).

A review is given of the geophysical effects of high-altitude nuclear explosions. The sources of information are mainly from the high altitude detonations in August and September 1958 in the Pacific and South Atlantic. The nuclear tests at Novaya Zemlya during October 1961 are also included. Various upper atmospheric phenomena, such as ionospheric and geomagnetic storms, airglows, trapped particles, and blast waves are identified as a consequence of nuclear explosions. An explanation of disturbance effects and the significance of controlled experiment in the upper atmosphere are discussed. (auth)

14502 MOTIONS OF THE AURORA AND RADIO-AURORA AND THEIR RELATIONSHIPS TO IONOSPHERIC CURRENTS. K. D. Cole (Dept. of External Affairs, Melbourne). Planetary Space Sci., 10: 129-64(1963).

Averaged observations of the longitudinal motions in aurorae and the motion of radio-aurora suggests that both kinds of motion occur in the same part of the ionosphere as, and are in approximately the opposite direction to, ionospheric currents responsible for magnetic disturbance. The motion of visible aurorae and radio-aurora is concluded to be caused by the motion of a source of excitation, for it is considered that only in rare circumstances can ionization be maintained in the lower E region without such a source. The electric fields from solar wind and ionospheric winds drive current in the ionospheric ionization produced. In general there is flow of current from the solar wind to the ionosphere, across the ionization in the ionosphere and back to the solar wind. Ionospheric inertia and therefore ionospheric winds play an important role in deciding motions in the magnetosphere. When bombardment of the lower ionosphere from the magnetosphere connects the magnetospheric potential system with that of ionospheric winds, a short circuit along the geomagnetic field followed by readjustment of magnetospheric potentials takes place. This sequence in turn changes the motion of magnetospheric bombarding sources. This short circuit gives rise to spikes on magnetograms. Joule heating of the ionosphere during geomagnetic disturbance causes expansion of the ionosphere and therefore lift of the magnetosphere. The consequent lifting of lines of force of the geomagnetic field would contribute to the main phase of a magnetic storm. Likewise positive magnetic bays in H would be smaller in general than negative bays. It is suggested that three broad regions of the globe with distinctive characteristics exist: equatorwards of the auroral zone, owing to protection from the solar wind, gradients of pressure and hence currents in the outer magnetosphere connected to this region are small. Ionospheric currents are determined here principally by ionospheric winds. Considering a horizontally elongated filament of ionization (suggested by an

auroral arc) the horizontal current parallel to the faces of it is very much greater than the current normal to its faces. In a second region in and near the auroral zone both electric fields from the magnetosphere and ionospheric wind combine to determine ionospheric current flow. Magnetospheric currents, driven by gradients of pressure in the magnetosphere, drive currents that are continued in the ionosphere along and across the geomagnetic field. In this region normal and parallel currents may be of similar order. Over the central polar caps a third region exists, in which the pressure gradient is simply that it is opposite the parallel current in direction. Over large areas of the globe this conclusion becomes that the auroral motion is approximately in the direction of motion of ionospheric electrons and of the same order of magnitude in speed. (auth)

14503 REFLECTION MECHANISMS FOR RADIO AURORA. P. A. Forsyth (Univ. of Western Ontario, London, Can.). Planetary Space Sci., 10: 179-86(1963).

Attempts to derive useful information concerning the degree of ionization in the auroral atmosphere from radio measurements are discussed. One view is that the radar echoes result from relatively slight variations in the spatial distribution of ionization, which variations cause partial reflection of the radio waves. The alternative view is that the radio waves are totally reflected by isolated strong concentrations of ionization. The main features of both mechanisms can be combined in one treatment. This treatment seems to be physically reasonable and consistent with radar measurements. It appears that multiple-frequency radio observations can be used to measure peak electron densities (concentrations) with confidence, and more detailed interpretations, involving the spatial distribution of the ionization, are a distinct possibility. (auth)

14504 OPTICAL STUDIES OF PARTICLE BOMBARDMENT IN POLAR CAP ABSORPTION EVENTS. B. P. Sandford (Arctic Inst. of North America, Washington, D. C.). Planetary Space Sci., 10: 195-213(1963).

The intensities of the polar-glow auroral emissions produced by bombarding protons during a polar cap absorption event are calculated. The first negative bands of N_2^+ have a maximum brightness at a height of 65 km. The enhancement of the forbidden atomic oxygen line at 5577 Å is most likely produced by dissociative recombination of O_2^+. Comparison of the calculated and observed polar-glow intensities indicate that the proton energy spectrum is approximately the same at all geomagnetic latitudes above 60°. This observation implies that there is a terrestrial cut-off at about 1 Mev, even at the geomagnetic pole, or that there are relatively few protons of less than 1 Mev energy emitted from the solar flare. The time variations of the polar-glow indicate that the magnetic field in the plasma cloud produced by the flare may be the main trapping region for the protons. The observations tend to support a blast model for the propagation of solar flare particles through interplanetary space. The origin of the great auroral displays observed during the large magnetic storms is briefly reviewed. (auth)

14505 TEMPERATURE AND CORPUSCULAR HEATING IN THE AURORAL ZONE. T. M. Mulyarchik (Inst. of Physics of the Atmosphere, Moscow) and P. V. Shcheglov. Planetary Space Sci., 10: 215-18(1963).

Results of observations on the temperature of the polar atmosphere and some possible heating mechanisms are discussed. (auth)

14506 THE ENERGIZATION OF PLASMA IN THE MAGNETOSPHERE: HYDROMAGNETIC AND PARTICLE-DRIFT APPROACHES. C. O. Hines (Defence Research Board, Ottawa). Planetary Space Sci., 10: 239-46(1963).

Large-scale electric fields exist in the magnetosphere, capable of convecting the low-energy plasma that exists there and perturbing the trajectories of the high-energy particles. Both the plasma and the particles undergo energy changes as a result. These changes may be described hydromagnetically, with the aid of thermodynamic concepts, or on the basis of particle-drift theory. It is shown that these two approaches are quite equivalent on the differential scale, and that some degree of equivalence can be maintained on the integral scale. (auth)

14507 OBSERVATIONS AND EXPERIMENTS PERTINENT TO AURORAL THEORIES. Anders Omholt (Norwegian Inst. of Cosmic Physics, Oslo). Planetary Space Sci., 10: 247-62(1963).

Observational results pertinent to theories on auroral primary particles in space are reviewed. Information on the properties of primary particles derived from optical observations are first discussed. It is pointed out that even if fast electrons are responsible for the main auroral forms, there is a possibility that proton precipitation zones exist outside those of electrons (as seen from the poles), where protons may be the dominating kind of energetic particles injected into the atmosphere from space. The general morphology of aurora is discussed, emphasizing the need for obtaining a consistent picture of auroral morphology of aurora is discussed, emphasizing the need for obtaining a consistent picture of auroral morphology when the tilting and rotation of the magnetic dipole axis is taken into account, and relating the subject to theoretical view-points. Observations and theoretical interpretations of auroral dynamics are reviewed and discussed. Pertinent satellite observations of energetic particles and magnetic fields in space are described and discussed. It is concluded that although storage of particles in the radiation belts is intimately connected with aurorae, it is unlikely that aurorae are produced by particles stored for any length of time in the Earth's magnetic field, except perhaps in a few special cases. Model experiments in the laboratory on auroral theories are also discussed. (auth)

14508 IONOSPHERIC STORMS AND THE MORPHOLOGY OF MAGNETIC DISTURBANCES. H. Rishbeth. Planetary Space Sci., 11: 31-43(Jan. 1963).

Ionospheric storms may either increase or decrease the critical frequency foF2, and are accordingly described as "positive" or "negative." The form of the magnetic changes which accompany ionospheric storms is discussed. Magnetic data for four stations were used to derive SD and Dst variations, for groups of ionospherically "positive" and "negative" storms. The SD variation of the magnetic H elements is found to differ for "positive" and "negative" storms at three mid-latitude stations (Washington, Greenwich, Christchurch). These differences are smaller in the magnetic D and Z elements. The SD current systems are thought to be located in the ionosphere, and the meaning of these differences is discussed, particularly with regard to the position of the SD current focus: references is made to the extensive analysis by Sugiura and Chapman. At a lower latitude station (Hawaii), the magnetic SD is the same for both types of ionospheric storm. The magnetic Dst variations, which are probably due to a ring-current external to the earth's atmosphere, are essentially similar for both "positive" and "negative" ionospheric storms. (auth)

14509 ELECTRIC FIELDS IN THE IONOSPHERE AND THE EXCITATION OF THE RED LINES OF ATOMIC OXYGEN. Lawrence R. Megill, Manfred H. Rees, and Leann K. Droppleman (National Bureau of Standards, Boulder, Colo.). Planetary Space Sci., 11: 45-56(Jan. 1963).

A detailed formulation for obtaining the excitation rate of optical emissions by electrons heated by a d-c electric field is presented. The energy distribution of the electrons is obtained by solving the Boltzmann equation, including all the inelastic collisions of importance in the region of the atmosphere from which airglow and auroral radiations originate. An electric field of 2×10^{-3} v/cm orthogonal to the geomagnetic field results in an intensity of the red lines of atomic oxygen of about 5 kR, such as is observed in the midlatitude subvisual red arcs, with the height of maximum emission at approximately 400 km. The magnitude of electric fields considered are not sufficient to produce any measurable magnetic effects; however, appreciable heating may result. The origin of the electric field is not explored. (auth)

14510 ON THE ASSOCIATION BETWEEN SUBVISUAL RED ARCS AND THE Dst (H) DECREASE. M. H. Rees (Univ. of Colorado, Boulder) and S. I. Akasofu. Planetary Space Sci., 11: 105-7(Jan. 1963).

Mid-latitude subvisual red arcs occurring during magnetic storms are described. There are differences between these red arcs and the polar red glows. The observational data available on the red arcs and the magnetic deflection of the horizontal component are summarized in a table and plotted. The possible excitation of the red arcs by heating of the electron gas is considered. (D.L.C.)

14511 DETERMINATION OF LONG-LIFE β RADIOACTIVITY IN ATMOSPHERIC FALL-OUT. V. I. Baranov and V. D. Vilenskii. Radiokhimiya, 4: 486-92(1962). (In Russian)

A method is suggested for determining Sr^{90}, Cs^{137}, Ce^{144}, and Pb^{210} in atmospheric precipitation and fallout. The method is capable of measuring a large sample of atmospheric precipitation or 5 to 10 g of atmospheric dust containing 10^{-10} to 10^{-11} C in one sample with an accuracy of ±5 to ±10%. (R.V.J.)

14512 LEAD-210 FALL-OUT IN ATMOSPHERIC PRECIPITATION. V. I. Baranov and V. D. Vilenskii. Radiokhimiya, 4: 493-6(1962). (In Russian)

Measurements on fallout indicated Pb^{210} may be an important component of natural background radioactivity. Data on precipitation were used for estimating the possible elimination of Pb^{210} from the air. (R.V.J.)

14513 BALL LIGHTNING. Harold W. Lewis. Sci. Am., 208: No. 3, 107-8; 110; 112; 114; 116(Mar. 1963).

An explanation of ball lightning is offered which takes into account the properties attributed to it by those who have seen it. The size, duration, color and other physical properties of the ball obtained from actual observers form the basis of the description given. (C.E.S.)

14514 NUCLEAR EXPLOSIONS: SOME GEOLOGIC EFFECTS OF THE GNOME SHOT. Leonard M. Gard (U. S. Geological Survey, Denver). Science, 139: 911-14 (Mar. 8, 1963).

The explosion of the Project Gnome device, which had a yield of 3 kt and was exploded at a depth of 1200 ft in a thick salt deposit, is described. The geologic formations above and below the explosion site were described, as they appeared before and after the shot. The shot chamber consisted of a 7 × 7 × 8 ft room with a self-sealing entrance. Drilling studies indicated upward and downward shifting of the overlying and underlying formations respectively. Analysis of formations near the walls of the post-shot cavity (volume 25,000 cubic yards) showed the presence of intrusive breccia veins composed of black salt containing minerals created by the blast. These veins were associated with complex thrust faulting in the rocks adjacent to the shot chamber. The presence of low-burning fragments (wood, rubber, etc.) in the intrusions was noted, which fragments indicated that excessive temperatures were not reached all through the chamber. (T.F.H.)

14515 DETECTION OF NUCLEAR EXPLOSIONS. V. I. Keylis-Borok and L. N. Malinovskaya. Tr. Inst. Fiz. Zemli, Akad. Nauk SSSR, No. 20, 117-24(1962).

The radiation of rarefaction waves in certain directions is one of the identification criteria for nuclear explosions and can be successfully applied if the transmission paths along which these waves are radiated can be detected by a sufficient number of stations. An estimate of the probability of such a case for a network of detection stations is presented. It is shown that in this (unlikely) situation it is rather simple to identify earthquakes from the arrival signals of transverse waves. (P.C.H.)

14516 DEPENDENCE OF PREVAILING EXPLOSION AMPLITUDES ON THE SIZE OF THE CHARGE. I. L. Nerserov and A. V. Nikolaev. Tr. Inst. Fiz. Zemli, Akad. Nauk SSSR, No. 25: 95-100(1962). (In Russian)

Experimental data are given on the seismic amplitude frequencies of direct and reflected longitudinal waves as functions of explosive charge, weight, and placement. The data on the 1959 Fergana Valley experimental explosion were correlated with the frequencies produced by seismic waves during earthquakes. (R.V.J.)

14517 TRITIUM AND DEUTERIUM IN ATMOSPHERIC HYDROGEN. Bernhard Gonsior (Universität, Heidelberg) and Irving Friedman. Z. Naturforsch., 17a: 1088-91 (Dec. 1962). (In German)

T and D measurements on a set of atmospheric hydrogen samples of 1957 and 1958 are reported, the samples being taken nearly continuously only a few days apart. Appreciable variations are found, which are only partly due to local admixture of industrial H_2. One peak a factor of ten higher than normal was found, which is very probably due to direct injection of unburned tritium in a nuclear explosion. (auth)

14518 THE HELIUM AND NEON CONCENTRATION IN STONE METEORITES AND THEIR RADIOGENIC AND COSMOGENIC AGES. H. Hintenberger, H. Koenig, and H. Waenke (Max-Planck-Institut fur Chemie, Mainz). Z. Naturforsch., 17a: 1092-1102(Dec. 1962). (In German)

The total content as well as the isotopic composition of helium and neon of 19 chondrites and 5 achondrites were determined. A description of the analytical method is given. Large variations of the ratios He^3/Ne^{21} were observed and it is shown that these variations cannot be explained by differences in the chemical compositions of the meteorites only. Radiogenic helium ages and cosmic ray exposure ages were calculated. The calculation of the helium ages was mainly based on uranium determinations by means of the xenon-method previously developed in this laboratory. The radiogenic helium ages range from 0.42×10^9 to 4.5×10^9 years. The values obtained for the helium ages are compared with the figures for the potassium-argon ages formerly derived by a neutron activation method newly developed and of those stated in the literature. It turns out that in most cases the radiogenic helium ages are

lower, sometimes considerably lower than the potassium-argon ages indicating diffusion loss of helium and certainly in smaller quantities also of argon. Using tritium and sodium-22 decay rates from the literature for the calculations of the production rates for helium-3 and neon-22, cosmic ray exposure ages for all the meteorites analyzed were obtained. These exposure ages vary between 0.3×10^6 and 29×10^6 years. No correlation between radiogenic ages and cosmic ray exposure ages and no grouping of the exposure ages were found. (auth)

HEALTH AND SAFETY

Refer also to abstracts 13998, 13999, 14154, 14530, 14581, and 14589

14519 (AECL-1687) A REPORT ON THE EFFECTS OF THE CHEMICAL EXPLOSION OF DECEMBER 13, 1950 AT CHALK RIVER NUCLEAR RESEARCH LABORATORIES. J. N. Fairlie and A. J. W. Hitchman (Atomic Energy of Canada Ltd., Chalk River, Ont.). Jan. 1963. 8p.

The chemical explosion at Chalk River on December 13, 1950 resulted in one death and injury to several other employees. Although radioactivity was present it in no way contributed to the cause of the accident, nor were there any radiation injuries. The injuries and treatment are described. A record of radioactive contamination of the injured is included. The lessons learned from the accident are pointed out. (auth)

14520 (AEET/AM/23) EVALUATION OF HAZARDS TO POPULATION FROM A REACTOR ACCIDENT. V. V. Shirvaikar and R. N. Sachdev (India. Atomic Energy Establishment, Trombay). 1962. 36p.

Data and information obtained in investigation of an assumed activity release from a reactor which had operated at 1 Mw for 180 days and 360 days respectively prior to the accident are presented. The release conditions considered include those under which only volatile activity escaped, and those under which all of the 1 Mw gross fission product activity was released. (J.R.D.)

14521 (AEET/HP/R-11) EVALUATION OF MAXIMUM PERMISSIBLE CONCENTRATION OF RADIOISOTOPES IN SEA WATERS OF BOMBAY. K. C. Pillai and A. K. Ganguly (India. Atomic Energy Establishment, Trombay). 1961. 37p.

Significant radiation exposures to the population of Bombay may arise from the disposal of radioactive wastes at Trombay into the sea and the intake of radioactivity through the intake of salt manufactured from sea water or from the ingestion of fish harvested from the sea. Calculations were made of the possible effects of radiation from Trombay operations on the population of Maharashtra State. Calculated maximum permissible values are presented in tables. (C.H.)

14522 (AERE-R-4137) MEASUREMENT OF THE GAMMA RADIATION BACKGROUND. J. A. B. Gibson (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Dec. 1962. 16p.

The gamma radiation dose rate was measured continuously over open grassland at Grove, Berkshire, from Sept. 1961 to Aug. 1962. The dose rate from cosmic radiation was 3.2 μr/h, i.e., 26 mr/year and from the natural radioactivity in the soil 5.3 μr/h, i.e., 46 mr/year. Fallout from nuclear weapon tests gave a further 21 mr during the 12 months of measurement. Analysis of the gamma-ray spectrum from the fission products reveals that the total dose from Cs^{137} was 2 mr, from Nb^{95}-Zr^{95}, 15 mr, from Ru^{103}-Rh^{106}, 3 mr, and from short lived activities, mainly Ba^{140}-La^{140}, 1 mr. The analysis of the background radiation into its components using a gamma-ray spectrometer operated over the Grove site showed also that the majority of the dose rate was in the energy range 0.1 to 2.0 Mev. The assessment of certain available ionization chambers, scintillation chounters and Geiger-Müller counters over this range of energies showed that only the ionization chambers give a true measure of the dose rate. (auth)

14523 (ARF-3187-7) ELECTROSTATIC CLASSIFICATION OF SUBMICRON AIRBORNE PARTICLES. Progress Report, April 1–June 1, 1962. G. Langer (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Contract AT(11-1)-578. 8p.

Emphasis in the study was on particles below 0.1 μ. Efforts during the period were devoted to development of the ARF electric particle charger. Work on the Whitby ionizer as a charger was also continued. Tests were conducted in which relatively high charging levels were achieved. Neutralization studies were continued in which carbonyl iron aerosols produced by dry dispersal were neutralized. The classifier was modified to accommodate a higher sample rate. (J.R.D.)

14524 (ARF-3187-11) ELECTROSTATIC CLASSIFICATION OF AIRBORNE PARTICLES. Final Report, August 16, 1961–January 31, 1963. G. Langer (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Jan. 31, 1963. Contract AT(11-1)-578. 52p.

Classification of particles as small as 0.006-μ-dia. was shown to be feasible, and good classification of atmospheric dust was achieved. However, a practical solution to the problem of overlapping between particles larger and smaller than 0.1 μ, the point of minimum electric mobility, was not found. A thorough understanding of the charging conditions required for good classification was obtained. Charging must take place in a very high field gradient to achieve the square-law relationship necessary for good classification of particles 0.1 μ or larger. For smaller particles a 1.3 power relation was achieved and found adequate. A standard corona discharge cannot be used because it breaks down at about one-third the necessary potential. By using a discharge electrode of relatively small curvature and a very smooth ground electrode arrangement, potential gradients up to 30 kv/cm were achieved. A new charger configuration was devised to reduce charger precipitation to a very low level. It was possible to operate this charger for long periods with good results. A 12 l/min cylindrical classifier was constructed and operated. This unit was analyzed mathematically to determine particle trajectory characteristics. (auth)

14525 (BNL-6767) PERSONNEL DOSIMETRY OF VERY HIGH ENERGY RADIATIONS. Frederick P. Cowan (Brookhaven National Lab., Upton, N. Y.). [1962]. Contract [AT(30-2)-Gen-16]. 9p.

Two basic methods of dosimetry applicable to high energy radiation areas are briefly reviewed, and the problem of μ-meson dosimetry is examined theoretically. Experimental results indicate that standard methods of film badge interpretation may be used for rem dose determinations in μ-meson areas. Preliminary measurements on dosimetry of proton beams indicate a need for more research and careful control of exposures. (D.C.W.)

14526 (CEA-2223) LES POLLUTIONS RADIOACTIVES PAR L'IODE 131 EN FRANCE DU 1er NOVEMBRE 1961 AU 1er FEVRIER 1962. (Radioactive Pollutions by Iodine-131 in France, from November 1, 1961 to Febru-

ary 1, 1962). Lucien Jeanmaire and Georges Michoud (France. Commissariat a l'Énergie Atomique. Centre d'Études Nucléaires, Fontenay-aux-Roses). 1962. 4.9p.

Results of I^{131} measurements on 450 milk samples, on 27 animal thyroids, and on 311 human thyroids between November 1, 1961, and February 1, 1962, are given. These results show that the I concentrations have come close to a critical level, and that if the Soviet series of explosions had continued it would perhaps have been necessary to take sanitary precautions. The discussion concerns the determination of the moment when such steps should be taken. (auth)

14527 (HW-SA-2809) ENVIRONMENTAL RADIOACTIVE CONTAMINATION AS A FACTOR IN NUCLEAR PLANT SITING CRITERIA. E. C. Watson and C. C. Gamertsfelder (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 14, 1963. Contract W-31-109-eng-52. 57p. (SM-39/20)

The understanding of environmental exposure problems associated with nuclear energy has not maintained the advanced progressive pace that was attained in the beneficial uses of nuclear energy. For normal operations of chemical processing facilities and for the accidental release associated with power reactors, ingestion is the most important path of environmental exposure resulting from the atmospheric release of fission products. Depending upon the meteorology of any particular site, land activities at distances as far as 50 km may be affected. A sizable release of fission products will have far reaching effects on dairying or agricultural operations. The distances at which land use restrictions may be required are such as to preclude eliminating the problem of site selection. Emphasis must be placed on confinement of the radioactivity within the facility. (H.G.G.)

14528 (HW-SA-2862) RESEARCH NEEDED TO INSURE WATER QUALITY FOR FISHERIES WITH THE DEVELOPMENT OF ATOMIC ENERGY. R. F. Foster (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Jan. 2, 1963]. Contract AT(45-1)-1350. 18p.

The ecological effects of the discharge of radioactive materials, heat, and chemically toxic materials into water upon the fish populations in the affected areas are reviewed. It is concluded that radioactive effluent handling facilities and techniques reduce the radiation effects on the fish (and on the people who eat the fish) to an acceptable level, and that this level is probably lower than those of the effects of heat and chemical toxins. It is admitted that the analysis is based on a spotty knowledge of radiation effects on aquatic ecologies. (T.F.H.)

14529 (MRL-TDR-62-29) ELECTROCHEMICAL LIGHT MODULATOR. John F. Aitken (Philco Corp., Blue Bell, Penna.). Apr. 1962. Contract AF33(616)-7928. 54p. (AD-283118)

An electrochemical device was developed to automatically provide vision protection for aircraft personnel during nuclear flashes. The requirements were that it have an optical density of 4 with 50 μsecs, clear in 1 sec, and have an open-state transmission of 33% for visible light. In the original cell design, difficulties were encountered with the fabrication of conducting glass plates, contact resistances, and heavily loaded parallel circuits. To eliminate these difficulties, design changes were made. However, completed cells are not entirely satisfactory. All of the specifications, therefore, could not be met. Improvements are still possible in the size and weight of the electronic package and in the lens plating time. It is concluded that, by placing 5 cells (with series-connected subelements) back-to-back, fabrication difficulties will be reduced and specifications met. (auth)

14530 (MRL-TDR-62-46) THE DYNACELL AND FOCAL PLANE CONCEPTS OF PHOTOTROPIC SYSTEMS APPLICATION TO OPHTHALMIC NUCLEAR FLASH-PROTECTIVE DEVICES. Robert W. Harries (Polacoat Inc., Blue Ash, Ohio). May 1962. Contract AF33(657)-7450. 12p. (AD-284059)

Two concepts of phototropic systems application are presented. These concepts, when considered individually or in combination, make possible the development of improved, directly or indirectly actuated, phototropic, ophthalmic, nuclear flash-protective devices. By the application of a phototropic filter at the focal plane of an optical system, the attenuation of the phototropic response owing to distance is minimized. Using a renewable fluid filter, a concept is presented which offers the opportunity to use the more sensitive irreversible phototropic systems while still providing reversible characteristics. The operating characteristics of these concepts are presented along with some derived theoretical relations. (auth)

14531 (NDL-TR-32) COLD WEATHER DECONTAMINATION STUDY — McCOY II. Joseph C. Maloney, John L. Meredith (Army Chemical Corps Nuclear Defense Lab., Army Chemical Center, Md.), James Barnard, and Charles C. Kilmer (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). July 1962. 199p. (AD-290358)

Results of a program to obtain data on the efficiency of decontamination techniques under below-freezing conditions when applied to outdoor surfaces are presented. Fallout simulant was prepared by tagging 150μ to 300μ sand with La^{140}. The simulant was then dispersed onto snow, frozen soil, and roof surfaces. The techniques of fire hosing, snow plowing, and power sweeping were tested on 20' x 100' plots and a 4-acre living quarters complex. Data were obtained on decontamination effectiveness, work and dose rate, and fallout migration. (auth)

14532 (NP-12513) PRELIMINARY HAZARDS SUMMARY REPORT [ON] SOUTHERN CALIFORNIA EDISON COMPANY NUCLEAR STATION AT CAMP PENDLETON, CALIFORNIA. UNIT NO. 1. PART B. (Southern California Edison Co., Camp Pendleton, Calif.). Jan. 1963. 285p.

The design of the proposed 395-Mw(e) nuclear power plant is described, and results are presented of the hazards analysis. Credible and other accidents are considered, and the safeguards provided to minimize these accidents are described. (D.L.C.)

14533 (NP-12534) FALLOUT FROM MULTIPLE SURFACE BURSTS. (Army. Combat Developments Command. Office of Special Weapons Development, Fort Bliss, Tex.). Feb. 1963. 63p.

This study examines the effect of receiving fallout from more than one source on decay and total dose calculations and predictions and examines the adaptability of the current Army fallout prediction system to the multiple fallout situation. Simple procedures for the above situations are suggested for use in field situations. (auth)

14534 (NP-12581) ASSAY OF STRONTIUM-90 IN HUMAN BONE IN THE UNITED KINGDOM, RESULTS FOR 1961, PART II. Medical Research Council Monitoring Re-

port Series No. 5. (Gt. Brit. Medical Research Council, London). Nov. 23, 1962. 19p.

Results of analyses of strontium-90 in samples of human bones mainly from subjects who died in the second half of 1961 are presented. Nuclear weapon testing was resumed in the autumn of 1961, but no significant effect on the strontium-90 content of bone was observed. (H.G.G.)

14535 (NP-12590) SIMULATED COLD WEATHER RADIOLOGICAL DECONTAMINATION OF RECOVERY EQUIPMENT. Alfred E. Hanna (Naval Civil Engineering Lab., Port Hueneme, Calif.). Jan. 15, 1963. 13p. (TN-481)

Development of suitable AW decontamination materials, equipment, and techniques for use in tempreatures down to −10°F is discussed. Tests were conducted in which compressed air, steam, vacuum, water, and antifreeze solution were used to remove a fluorescent fallout simulant from a large tractor. It is concluded that antifreeze solution and water, if warmed, are the most effective materials; steam may be acceptably effective, and air and vacuum have limited use. (auth)

14536 (SCPRI(A)-83) NOTE D'INFORMATION SUR LA REGLEMENTATION GENERALE DES RADIOELEMENTS. (Note of Information on Drawing up General Regulations for Radioelements). (France. Serving Central de Protection contre les Rayonnements Ionisants, Paris). Jan. 1963. 21p.

Because of the number of requests for information on the conditions for the utilization of radioisotopes, a tabulation was made of the regulations pertaining to this subject. The first part contains the texts already published in the Code de la Santé Publique or in the form of decrees or edicts, relative to the general condition of storage and utilization of radioisotopes, to the conditions for the use of radiations on the human body, and to the functioning of the Commission Interministerielle des Radio-Elements. The second part contains regulations to be published or issued in the form of decrees. (J.S.R.)

14537 (SCPRI(M)62-11) RAPPORT D'ACTIVITE, NOVEMBRE 1962. (Report of Activities, November 1962). (France. Service Central de Protection contre les Rayonnements Ionisants, Paris). 53p.

The results of the radiological monitoring of the atmosphere, nuclear sites, rain waters, and the food chain are briefly summarized and shown graphically. (J.S.R.)

14538 (SCPRI(RM)-62-12) RAPPORT D'ACTIVITE, DECEMBRE 1962. (Report of Activities, December 1962). (France. Service Central de Protection contre les Rayonnements Ionisants, Paris). 50p.

The results of the radiological monitoring of the atmosphere, nuclear sites, rain waters, and the food chain are briefly summarized and shown graphically. (J.S.R.)

14539 (TID-17907) STUDIES ON MARINE FOOD CHAINS WHICH COULD INTRODUCE RADIOACTIVE MATERIALS TO MAN, AND ON ANNUAL CHANGES IN CERTAIN NATURAL POPULATIONS. Final Report. Ralph W. Dexter (Kent State Univ., Kent, Ohio). Dec. 1962. Contract AT(11-1)-411. 14p.

Progress is reported in studies on marine food chains that could introduce radioactive materials to man. Stomach analyses were made on whiting, redfish, and pollock landed by commercial fishing boats at Gloucester, Mass., during the summers of 1959 through 1961. Dietary data are summarized. Studies were made on the intertidal and shallow subtidal communities at Cape Ann, Mass., during the same period. A comparison of field sampling to those made in 1933 to 1937 showed that the marine communities have remained remarkably stable over the past 29 years. Radioactive fallout added to the environment over the past 15 years showed no apparent adverse effect. Results are included from a long-term ecological study of ponds and rivers in northeastern Ohio and east-central Illinois and studies on annual changes in the populations of chimney swifts and Japanese beetles in Portage County, Ohio. (C.H.)

14540 (TID-18021) THE ECOLOGY OF ACANTHARIA IN RELATION TO THE CIRCULATION OF Sr IN THE SEA. Progress Report, September 30, 1962. Bruno Schreiber (International Atomic Energy Agency, Vienna). Contract IAEA 62/US. 16p.

Progress is reported in studies on the concentration of natural and radioactive Sr by the marine plankton Acantharia. Procedures are outlined for the radiochemical analysis of plankton. Results are reported from the analysis of samples collected in the Tyrrhenian Sea and in the Adriatic Sea. The ecology of Acantharia in relation to the concentration of Sr in sea water is discussed. (C.H.)

14541 TRITIUM HAZARDS ASSOCIATED WITH A HEAVY WATER MODERATED REACTOR. W. T. Morecraft (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Am. Ind. Hyg. Assoc. J., 24: 87-90(Jan.-Feb. 1963).

To control the hazards of tritium exposures at the NRU reactor of Atomic Energy of Canada Limited, a varied safety program emphasizes education, monitoring, exhaust ventilation, protective clothing, and biochemical analyses for tritium in the body. The ICRP standard of 5×10^{-6} $\mu c/cm^3$ is used for maximal permissible exposure. Tritium release is controlled by operational procedures and ventilation. (auth)

14542 RADIATION DOSE TO POPULATIONS IN GREAT BRITAIN FROM MEDICAL AND NATURAL SOURCES. F. W. Spiers (Univ. of Leeds, Eng.). Am. J. Public Health, 52: 1377-84(Sept. 1962).

Results of a survey to determine radiation from medical sources to populations in England, Wales, and Scotland, as well as studies to determine the average gamma-ray dose to populations in some areas of Scotland are presented. (Public Health Eng. Abstr., 42: No. 12, 1962)

14543 REDUCTION OF DOSE IN MEDICAL AND INDUSTRIAL RADIOGRAPHY. Hanson Blatz (Department of Health, New York). Am. J. Public Health, 52: 1385-90 (Sept. 1962).

The need for radiation control in medical and industrial situations is discussed, along with ways and means to achieve this aim. (P.C.H.)

14544 SURVEILLANCE FOR RADIOLOGICAL CONTAMINATION IN FOODS. Ernest C. Anderson (Public Health Service, Washington, D. C.) and Donald J. Nelson, Jr. Am. J. Public Health, 52: 1391-1400(Sept. 1962).

The operation of a program for total diet assay of radioactivity directed at a critical age group is described. Results from the program provide meaningful data but not in adequate detail for control measures. (P.C.H.)

14545 SCATTERED RADIATION AND NEUTRON FLUX MEASUREMENTS AROUND A 35 Mev BETATRON INSTALLATION. Jack Spira (Montefiore Hospital, New York). Am. J. Roentgenol., Radium Therapy Nucl. Med., 89: 575-83(Mar. 1963).

A radiation protection survey was performed around a 35-Mev betatron unit. Radiation levels caused by 35-Mev roentgen rays and 35-Mev fast electrons were checked in

all rooms adjacent to the betatron room. Tabulated results show that the concrete and baryte concrete walls provide excellent protection for roentgen-ray and electron radiation. Neutrons originating in the lead collimators through (γ,n) photonuclear reaction and passing through the lead door were counted. Fast and slow neutron fluxes are tabulated. Results are discussed and ways to ensure minimum exposure to operating personnel and nonoccupational individuals are presented. (auth)

14546 PREDETERMINATION OF AVOIDABLE OR UNAVOIDABLE RADIATION HAZARDS AND COMPLICATIONS—CALCULATED RISKS. Franz Buschke (Univ. of California, San Francisco). Am. J. Roentgenol., Radium Therapy Nucl. Med., 89: 649-53(Mar. 1963).

A realistic appraisal of the true magnitude of a few of the more common frequently exaggerated risks of practical importance associated with radical radiation therapy of some of the commom forms of radiocurable cancer is presented. The conclusions are based mainly on detailed, recorded, and previously documented observations of some 3000 patients. Principles, which have guided treatment policies, are briefly summarized. It is suggested that, in general, morbidity and functional impairment associated with properly indicated and competently executed radiation therapy are far less serious than those accepted as a matter of course in the surgical treatment of many forms of cancer. (P.C.H.)

14547 FUNDAMENTALS OF RADIATION HYGIENE. H. Langendorff. Arch. Hyg. Bakteriol., 146: 81-92(May 1962).

14548 REMOTE HANDLING AT PETTEN. THE LABORATORY FOR HIGHLY RADIOACTIVE OBJECTS (LSO). H. J. Wervers and O. B. Vrijburg. Atoomenergie Haar Toepassingen, 4: 272-7(Nov. 1962). (In English)

A description is given of the construction, layout, and equipment of a laboratory associated with a research reactor–materials testing reactor center. Attention is given to hot-cell and lead-cell facilities, and ventilation and air-cleaning systems. (T.F.H.)

14549 RADIOSTRONTIUM AND RADIOCESIUM IN DRINKING WATER IN THE UNITED KINGDOM, 1961 RESULTS. Brit. Waterworks Assoc. J., 44: 415-21(July 1962).

During 1961 the concentration of Sr^{90} and Cs^{137} was measured regularly in 23 public drinking waters. None was found in 2 well-derived waters in Brighton and Wolverhampton. In the only water derived from a chalk stream, Southampton, the level of Sr^{90} was low (0.029 pC/l). In the river-derived waters, except Southampton and London, the average level of Sr^{90} was 0.18 pC/l. London's water was somewhat higher than average (0.25 pC/l). Excluding the Thames-derived London water (the average level of which was 0.84 pC/l) the average level of Cs^{137} in river-derived waters was 0.023 pC/l. The level of Sr^{90} in impounded waters ranged from 0.24 to 0.80 pC/l; the average level was 0.52 pC/l. The level of Cs^{137} in impounded waters was generally low (0.14 pC/l) but Glasgow and Belfast were higher (0.46 and 0.55 pC/l, respectively). The average daily ingestion of Sr^{90} and Cs^{137} in drinking water in 1961 is estimated at 0.25 pC per person and 0.13 pC per person, respectively. (Public Health Eng. Abstr., 42: No. 12, 1962)

14550 IONIZING RADIATION AND CHEMICAL PROTECTORS. Z. M. Bacq (Université, Liège). Giorn. Ital. Chemioterapia, 6-9: 207-12(July-Sept. 1962). (In Italian)

An interpretation is put forward according to which free radicals play a vital role in the protection of mammals from x or gamma radiations. Chemical protectors have brought to light a large number of important radiobiological phenomena and have given an undoubted impulse to the progress of radiation protection. In practice the use of chemical protectors is limited, except in the case of atomic war, when vast areas would be devastated. However, no method of local protection has yet been devised. (P.C.H.)

14551 NEW ASPECTS IN THE DEVELOPMENT OF RADIO-PROTECTANT DRUGS. T. J. Haley (Univ. of California, Los Angeles). Giorn. Ital. Chemioterapia, 6-9: 213-24(July-Sept. 1962). (In English)

A review was made of the effectiveness of over 1300 compounds utilized as radioprotectant agents. It was concluded that, in general, the most effective compounds contain an amino group 2 carbon atoms from a sulfhydryl group, but there are varying degrees of activity even in the same series of compounds. The most effective compounds presently available are the mercaptoalkylisothiouronium derivatives. The series of compounds that have lesser activity are the aminoalkylthiols and the amine oxides. (P.C.H.)

14552 THE DEVELOPMENT OF REGULATORY STANDARDS. Lester R. Rogers (U. S. Atomic Energy Commission, Washington, D. C.). Health Phys., 9: 1-5 (Jan. 1963).

A discussion is presented of the development of regulatory safety standards and criteria by AEC. The needs for such standards, their basis, and some of the work now going on these standards are discussed. (D.L.C.)

14553 LEGAL ASPECTS OF RADIATION INJURIES AND COMPENSATION. Herzel H. E. Plaine (Office of Legal Counsel, Dept. of Justice, Washington, D. C.). Health Phys., 9: 7-12(Jan. 1963).

There are a half dozen background factors in considering legal liability for and compensability of radiation injuries for persons occupationally exposed to radiation. First, all persons, as well as those occupationally involved, are regularly exposed to radiation. Occupational exposure is but a small percentage of the overall from all sources. Second, existing medical knowledge can tell us much about the damage inflicted by acute massive doses of radiation (and some of this is discussed) but very little concerning lesser doses spread over a period of time. Note also the unresolved conflict between the linear and threshold theories. Third, in the atomic energy industry the record of accidental high exposures has been very good and limited to a few cases. The more likely problem area may arise in cases where there is evidence only of very low exposures bordering on the "risk" levels set by law of 5 rem per year. Fourth, these maximum standards of exposure for workers are on the extremely low side, unrelated to any evidence of damage. They rest on the concept of minimizing risk. In the present state of medical knowledge, it can hardly be said that an insubstantial exceeding of the radiation protection guide or maximum permissible exposure limits, which are fixed in AEC regulations, is injury or causative of injury. Testimony in the recent Kellogg Company case (McVey v. Phillips) is illustrative. Fifth, many of the diseases which may be induced by less than lethal doses of radiation do not manifest themselves for years after exposure; and, as in the cases of leukemia, skin cancer, and aplastic anemia, are produced by causes in addition to radiation. Sixth, some bodily malfunctions which radiation may induce, such as epilation and sterility, do not necessarily create a compensable disability under workmen's compensation law. Turning to compensation, most workers must look to workmen's compensation stat-

utes, generally administered by the states (with some comparable federal coverage). This is a strict, without fault, liability of the employer, but limited in amount, generally related to reduction in earning power. There is also the possibility of alternative or additional recovery for damages against any third party who caused or contributed to the injury, usually a common law action grounded in negligence or fault. In the light of the background considerations, the big problem for most potential claimants will be to establish that late emerging diseases or malfunctions are the result of exposure to, usually, low level radiation. The Kellogg Company case affords a recent example. Adding to claimants' difficulties are certain barriers in the workmen's compensation laws themselves, such as the limitations statutes on emergence of injuries. Recent thinking on the use of presumptions or a "contingent injury fund" raise problems of larger scope than just the industries or occupations that use radiation, and move into the area of general disability insurance. In that perspective they deserve fair study by labor, management and government. Meantime further study of the effects of low level radiation in man must continue. An immediate temporary assurance would be the removal by state legislatures of the time emergence barriers to action where latent diseases emerge years hence. (auth)

14554 SOME ASPECTS OF INHALATION DOSE CALCULATION FROM SINGLE EXPOSURES. Harry Levin (Marquardt Corp., Van Nuys, Calif.). Health Phys., 9: 41-4(Jan. 1963).

The simplicity of scaling inhalation doses leads to frequent application of such procedures. It is important to know, when such scaling is carried out, both the actual basis and the accuracy to be expected, from a mathematical standpoint. Attention is called to a general and simple method of scaling doses, comparing it to more rigorous relationships involving exposures with nuclides at constant concentration, and with nuclides at diminishing concentrations. These relationships are presented in analogous form to the scaling equation to facilitate comparison. The scaling procedure is found to be sufficiently accurate to warrant discriminant use with many nuclides and conditions of exposure. (auth)

14555 THE 1951 PREOPERATIONAL ENVIRONMENTAL SURVEY FOR THE SAVANNAH RIVER PLANT—IN RETROSPECT. W. C. Reinig (E. I. du Pont de Nemours and Co., Aiken, S. C.). Health Phys., 9: 83-5(Jan. 1963).

A discussion is presented of the experience gathered in the 18-month preoperational radiation survey of the plant environment. Some of the difficulties involved and the limitations of the data are described. It is concluded that the survey contributed to the effectiveness of the present environmental monitoring program. (D.L.C.)

14556 PROTECTING WORKERS FROM RADIATION SOURCES IN URANIUM MINES AND IN WORK WITH RADIOACTIVE MATERIALS. D. Karajovic, B. Panov, M. Jeremic, D. Djuric, M. Vukotic, and D. Gvozdanovic (Inst. of Occupational Medicine, Belgrade). Higijena (Belgrade), 14: 154-68(1962).

Data on radiation protection are presented and discussed. Methods for monitoring exposure, radioactive levels in water, air, and dust under and above ground are given, along with hemograms of 94 miners and 142 workers (95 men) in uranium technology. The main problems and dangers, remedies advocated, planned, or in effect are also discussed. (P.C.H.)

14557 IONIZING RADIATION IN THE SPACE ENVIRONMENT. Maxwell Dauer (Univ. of Miami, Fla.). Ind. Med. Surg., 30: 301-9(Aug. 1961).

The design and engineering of vehicles planned for man's exploration and travel in outer space are discussed in relation to hazards of various radiation sources. The radiation to which man will be exposed includes: primary and secondary cosmic radiation, protons and electrons present in the inner and outer Van Allen belts, and proton beams from solar flares. The most serious ionizing radiation hazard in the space environment is due to solar proton flares. Here, maximum use can be made of the vehicle design to reduce the extra weight of added shields. Prompt warnings of proton radiation from solar flares can be obtained by optical means and by detection of disturbances of radio communications. However, no reliable system is available to provide forecasts or predictions longer than a few days to warn of solar eruptions. (P.C.H.)

14558 HAEMATOLOGICAL PROBLEMS IN WORKERS OF NUCLEAR RESEARCH CENTERS. Enrico Ghislandi and Elsa Bazzano (Università, Milan; Centro Informazioni Studi Esperienze, Milan; and Centro Studi Nucleari Enrico Fermi del Politecnico, Milan). Med. Lavoro, 53: 179-86 (1962). (In Italian)

Relevant hematological data collected in two nuclear research centers in Milan were re-examined. The minimum normal leukocyte value was fixed at 4.000/mm^3 of circulating blood; it should be stressed that out of 279 subjects examined, who had not been exposed to irradiation, 6.4% showed a constitutional leukopenia in the course of periodical check-ups. From data on percentage of basophilic granulocytes in leukocyte counts, the percentage basophil value found on examining 325 blood samples of healthy individuals, was 0.97% in men and 0.91% in women. The mechanism by which ionizing radiations cause a fall in circulating basophils is discussed. The characteristics of binucleated lymphocytes are reviewed and it is pointed out that they occur more frequently in individuals exposed professionally to low doses of ionizing radiations; 2 binuclear lymphocytes are shown; they were found among 50000 observed lymphocytes in white cell counts of workers of nuclear centers; the findings were normal. (P.C.H.)

14559 DOSIMETRIC CHARACTERISTICS OF GAMMATRON-2. A. N. Krongauz, T. G. Pavlova, and A. V. Frolova (State Inst. of Roentgen-Radiological Research, Ministry of Health, USSR). Med. Radiol., 8: No. 1, 12-17(Jan. 1963). (In Russian)

Dosimetric characteristics of the Gammatron-2 during operation in a static regimen are presented. The air dose and the distribution of doses along the central ray of the beam and on the sides were determined. The protective properties of Gammatron-2 were studied. On the basis of the measurements, charts of isodoses were elaborated. (P.C.H.)

14560 ELECTRON MICROSCOPIC EXAMINATION OF HIGHLY RADIOACTIVE FALL-OUT PARTICLES. T. Mamuro, T. Seiyama, T. Matsunami, A. Fujita, and K. Yoshikawa (Radiation Centre of Osaka Prefecture). Nature, 197: 478-9(Feb. 2, 1963).

Electron microscopic examination of highly radioactive fallout particles produced by the series of nuclear explosions during Sept. and Oct. 1961 revealed that their surface states differed from particle to particle. It was concluded that most of the particles were produced by condensation followed by solidification of explosion products at relatively high temperature immediately after the

explosion and that volatile elements such as I^{131} and Ru^{103} condensed to form a film at relatively low temperatures. Submicron size particles became-attached to the surface through collision. (C.H.)

14561 CAESIUM-137 FROM FALL-OUT IN HUMAN MILK. A. Åarkrog (Danish Atomic Research Commission, Risö). Nature, 197: 667-8(Feb. 16, 1963).

Data are presented on the content of Cs^{137} in human milk as compared to Cs^{137} levels in the diet. Samples were collected in Denmark daily between Nov. 1961 and Sept. 1962. Levels of Cs^{137} in human milk were compared with levels in milk from dairy cows living in the same part of the country. Results indicate that babies fed on human milk could be exposed to greater Cs^{137} body burden than if they were fed on milk from dairy cows if the diet of the mother shows a greater Cs^{137}/K ratio than the cows' milk. (C.H.)

14562 RADIOLOGICAL QUANTITIES AND UNITS, THEIR INTER-RELATIONSHIPS AND CONDITIONS OF USE. J. W. Boag (Mount Vernon Hospital, Northwood, Middx., Eng.). Phys. Med. Biol., 7: 409-18(Feb. 1963).

Discussion is given on the system of quantities and units proposed in the latest recommendations of the International Commission on Radiological Units, which were adopted by the International Congress of Radiology. It was recognized that units such as absorbed dose, kerma, LET, and any other quantities depending only on energy, mass, and length may be expressed in appropriate units of any consistent system of physical units, such as CGS or MKS. Therefore, absorbed dose and kerma can be expressed in ergs/g or joules/kg. It is recommended that the rad, whose magnitude is 100 ergs/g, be used solely as a unit of absorbed dose and not for other quantities having the same dimensions, such as kerma. (P.C.H.)

14563 THE SIGNIFICANCE OF THE REM AND PARAMETERS ON WHICH IT DEPENDS. G. J. Neary (Medical Research Council Radiobiological Research Unit, Harwell, Berks, Eng.). Phys. Med. Biol., 7: 419-26(Feb. 1963).

Consideration is given to the concept of relative biological effectiveness (RBE) and the closely related concept of the rem. It was concluded that a person's biological status in relation to his radiation exposure within the limits of maximum permissible doses is assumed to be determined by the Dose Equivalent (DE), formerly known as RBE Dose, and by the particular tissues irradiated. DE is the product of absorbed dose and any necessary modifying factors, among which is the Quality Factor (QF). QF is a special case of RBE appropriate to permissible doses and is assumed to depend solely on LET. The conventional value at a given LET is assumed to apply to all tissues with the single exception of the lens of the eye. The rem is the unit of dose equivalent. The state of an individual following exposure corresponding to a given DE is deemed to be the same as if the same tissues had been irradiated with a numerically equal absorbed dose of hard x or gamma radiation. Doses greater than the maximum permissible cannot be converted into rems. (P.C.H.)

14564 INTERPRETATION OF INSTRUMENT READINGS: IONIZATION CHAMBERS. R. F. Farr (United Birmingham Hospitals and Queen Elizabeth Hospital, Birmingham, Eng.). Phys. Med. Biol., 7: 427-38(Feb. 1963).

The interpretation of ionization chamber readings is presented. Two main types of dosimeters are considered: personnel dosimeter and survey meter. Correction factors, which might be applied, and concomitant uncertainty in the interpretation of readings, especially for surface exposure, are outlined. (P.C.H.)

14565 THE INTERPRETATION OF FILM BADGE READINGS. B. E. Jones (Radiological Protection Service, Sutton, Surrey, Eng.). Phys. Med. Biol., 7: 439-44(Feb. 1963).

Problems in evaluating the dose received by the film in badges and in relating it to that received by the wearer of the film are discussed. However, solutions to the problems are not necessarily provided. Problems considered in the personnel dosimetry of x and γ radiation are: doses received by various organs; calibration of film badges; radiation sources for calibration purposes; experimental arrangement in film calibration; and angle of incidence of radiation upon the calibration films. Discussion is also given on the measurement of personnel doses of β and neutron radiations. (P.C.H.)

14566 INTERPRETATION OF INSTRUMENT READINGS: PULSE-COUNTING INSTRUMENTS. D. H. Peirson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phys. Med. Biol., 7: 445-53(Feb. 1963).

Interpretation of Geiger-Mueller, scintillation, and proportional counters is discussed. The first two are considered in response to x and gamma radiation and the third in response to slow and fast neutron radiation. (P.C.H.)

14567 EXPOSURE DOSE MEASUREMENTS. D. Greene, J. B. Massey, and W. J. Meredith (Christie Hospital and Holt Radium Inst., Manchester Eng.). Phys. Med. Biol., 7: 505-6(Feb. 1963).

Discussion is given on strictures put upon a previous article, Greene, Massey, and Meredith, Phys. Med. Biol., 6: 551(1962), on roentgen calibration in the determination of exposure dose in a phantom, by others. Discrepancies are noted and evaluated. (P.C.H.)

14568 EVALUATION OF THE DIAGNOSTIC X-RAY DEPARTMENT FROM THE RADIATION PROTECTION POINT OF VIEW. Stanisław Klevenhagen, Zdzisław Ozgo, and Jerzy Wojtowicz. Polski Przeglad Radiol. i Med. Nuklearnej, 26: 553-65(Nov.-Dec. 1962). (In Polish)

On the basis of measurements in 51 diagnostic x-ray departments in the city of Poznan, a periodical control of apparatus and rooms was considered necessary. Elements that should be taken into consideration are: evaluation of the department as a whole; checking of the tube housing for leakage radiation; and checking of the focus-table top distance and tube filtration as well. Measurements of the primary beam, namely, the dose rate at the table top and the quality of the beam by measuring of the half value layer should be made. Measurements of scatter radiation around the screen and the x-ray apparatus should also be carried out. The usage and effectiveness of the staff protective shields and gonad shields for patients should be checked. The primary beam as measured at the table top in routine screening conditions (70 kV, 3 mA, 3 mm Al of total filtration) should not exceed the dose rate 5 r/min. (auth)

14569 ACUTE RADIATION INJURIES IN DISASTER SITUATIONS. John J. Lang (Public Health Service Hospital, New Orleans) and Raymond T. Moore. Public Health Rept. (U.S.), 78: 17-21(Jan. 1963).

The treatment of radiation injuries in a disaster situation is discussed. It is pointed out that no new symptoms or signs are present that have not been observed in ordinary clinical practice. This is not a mystery disease. Little can be done for patients in the immediate period after exposure, except for reassurance, sedation, and, possibly, minimal fluid replacement. Patients who show radiation-induced skin erythema or conjunctivitis during the prodromal period usually will not survive under austere disaster circumstances. A drop in the absolute lymphocyte count

to very low levels during the first few days after exposure also indicates poor prognosis. Appearance of definite central nervous system signs usually indicates a fatal course. Recurrence of diarrhea after the fourth day also usually means the patient is unlikely to survive. If infections and bleeding precede epilation, the course is more severe. Treatment will be essentially symptomatic and replacement in character, consistent with available resources. Fallout contamination can be removed without significant hazard to decontamination personnel. A detergent and water shower with thorough scrubbing is the method of choice. However, in most situations, removal of clothing and firm wiping or brushing of the body will have to be relied upon, since adequate water supplies may not be available. Work techniques in the decontamination area should be strictly controlled to prevent spread of contamination to clean areas. (auth)

14570 COMITÉ CONSULTATIF POUR LES ÉTALONS DE MESURE DES RADIATIONS IONISANTES COMITÉ INTERNATIONAL DES POIDS ET MESURES. (Advisory Committee for Standards of Measurement for Ionizing Radiation in the Service of the International Committee on Weights and Measures). Paris, Gauthier-Villars & Cie, 1961. 35p.

The agenda of the 1961 meeting of the Advisory Committee is summarized briefly. In the annex, the reports of the four working groups — exposure dose, standard radionuclides, neutron standard sources, and radium standards — are given. The activity of the Ionizing Radiation Section for the period from March 1 to July 15, 1961, is also indicated. A letter requesting the investigation of reported irregularities in the use of symbols and definitions is also attached. (J.S.R.)

14571 RADIOLOGICAL HEALTH DATA, [MONTHLY REPORT], VOLUME III, NUMBER 12. (Public Health Service, Washington, D. C.). Dec. 1962. 60p. $0.50 (GPO).

Data are presented on radioactivity in samples of air, precipitation, food, milk, and raw surface waters collected throughout the U. S. during 1962. Factors influencing γ exposure dose to nonurban populations from the deposition of fallout are discussed. Data are included on levels of Cs^{137} in man determined by whole-body counting, levels of I^{131} in milk and vegetables associated with July 1962 fallout in Utah, and Sr^{90} in animal feeds from 1960 through 1962. Nuclear detonations announced during Nov. are listed. (C.H.)

14572 RADIOLOGICAL HEALTH DATA, [MONTHLY REPORT], VOLUME IV, NUMBER 1. (Public Health Service, Washington, D. C.). Jan. 1963. 62p. $0.50 (GPO).

Data are presented on radioactivity in samples of air, precipitation, food, milk, and raw surface waters collected throughout the U. S. during 1962. Radiological health programs and legislation in the various states governing the use of dental x ray machines are summarized. Data are included on environmental levels of radioactivity at Brookhaven National Laboratory and the Rocky Flats Plant from Jan. through June 1962, and levels of radioactivity in the vicinity of the Nevada Test Site in June 1963. A summary is included of nuclear detonations reported during Dec. 1962. (C.H.)

14573 BASIC SAFETY STANDARDS FOR RADIATION PROTECTION. (International Atomic Energy Agency, Vienna). Safety Series No. 9. 1962. 59p. (STI/PUB/26). $1.50; Sch 31.50, NF 6; DM 4.80(IAEA).

The standards of safety for protection of health and minimization of danger to life and property are presented in sections on maximum permissible doses, practical control of radiation doses, and fundamental principles. The standards are intended for application to production, processing, handling, use, storage, and transport of natural and artificially produced sources and to the disposal of radioactive substances. (J.R.D.)

14574 STRAHLENSCHUTZ IN FORSCHUNG UND PRAXIS. (Radiation Protection in Research and Practice). Freiburg i. B., Verlag Rombach & Co., 1961. 252p.

The fourteen papers presented at the Vereinigung Deutscher Strahlenschutzarzte in Freiburg from January 4-7, 1961, are compiled. The topics discussed include radiology and radiation protection, occupational radiation injury and its diagnosis, radiation protection precautions and carrying them out, radiation protection in industry and technology, dosimetry with special consideration of individual dosimetry, and problems on the elimination of radioactive wastes. The discussions on some of the papers are also included. (J.S.R.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

14575 (NYO-10144) RESEARCH ON APPLICATIONS OF KRYPTON 85. Fourth Quarterly Progress Report, July 1, 1962 to Sept. 30, 1962. W. G. Marancik and H. B. Fleishman (Air Reduction Co., Inc. Central Research Labs., Murray Hill, N. J.). Contract AT(30-1)-2906. 7p.

Acetylene was polymerized by radiation from krypton-85. The reaction was carried out at 14 atmospheres pressure. The solid polymer was pale yellow and soluble in acetone. The infrared spectrum indicates the presence of unsaturated carbon to carbon bonds. No reaction between the polymer and air was observed. Further investigation of acetylene polymerization is continuing. The polyvinyl acetate produced by krypton-85 radiation formed thin, brittle films which could not be used for tensile testing. Film molding techniques are being investigated. A krypton-85 self-luminous lamp was designed and fabricated. The light produced was of low intensity. (auth)

14576 (TID-17973) RADIOISOTOPES RESEARCH, DEVELOPMENT, AND RELATED ACTIVITIES. Quarterly Progress Report, September 15–December 15, 1962 (Sixteenth Quarter). (Chicago. Univ. Labs. for Applied Science). Jan. 1963. Contract AT(11-1)-712. 13p. (LAS-SR-161-55)

Activities during the period were concerned mostly with theoretical studies and report preparation. Some effort was devoted to checking the equivalence factors and a method for moisture determination in coal piles by neutron moderation, and in calibration and field testing of a modified gamma-scattering depth-density gage. Calibration data are included. Work on a method of chemical analysis by Rutherford scattering of alpha particles was confined to examination of literature on the subject pending arrival of a Cm^{242} source. Abstracts of talks presented on density and moisture gages, and on application of the Rutherford scattering of alpha particles to the chemical analysis of solids are included. (J.R.D.)

14577 APPLICATIONS OF RADIOACTIVELY LABELED MARKER PROTEINS IN DENSITY GRADIENT ULTRACENTRIFUGATION. P. A. Charlwood (National Inst. for Medical Research, London). Anal. Biochem., 5: 226-45 (Mar. 1963).

The general advantages of using internal reference substances to study rate of sedimentation in density gradients in the preparative ultracentrifuge are pointed out with reference to the particular suitability of radioactive-labeled ones. Some easily obtainable proteins, ranging in size from lysozyme to serum macroglobulin, were iodinated and are shown to be valid markers under various conditions. When two different isotopes were used, and in certain cases with only one, two markers could be used in the same tube. The method was used to control the preparation of normal and pathological macroglobulins, and in studying the size of anti-insulin antibodies, antinuclear antibodies and their antigen, and a viral antigen. (P.C.H.)

14578 GAMMA-RAY EXPLORATION OF GROUND. V. A. Artsybashev. Avtomob. Dorogi, No. 11, 15-16; 19 (1962).

A quantitative method is proposed for determining the absolute density of the ground (in g/cm^3) in road building from the attenuation of γ rays passing through it. The elements encountered in the ground can be divided into two groups according to their ability to absorb γ radiation: Si, C, N, O, Mg, S, K, Ca; and Al, Na, P, Fe. Curves showing the dependence of γ-ray attenuation on the surface density of the absorbing layer of the ground are constructed from analytical and experimental data for both groups. A separate curve is plotted for water because of its anomalous behavior in relation to γ-ray absorbability. The effect of humidity of the ground is taken into account. The diagram is valid only for certain γ-ray sources (e.g., Co^{60}) and detectors. In the terrain being explored two approximately parallel holes 1.0 to 1.5 m deep and 30 to 55 mm apart are bored. The source of radiation is placed in one and the detector in the other. From the measured values of radiation, the geometry of the bored holes, and the graph, the density of the ground between the holes can be easily determined, as well as the density variation with depth. A numerical sample calculation is given. (OTS)

14579 MEASUREMENT OF THE DENSITY OF MATERIAL OF GREAT THICKNESS BY BACK-SCATTERING OF A BEAM OF γ RAYS. Bernard Wack (Université, Grenoble, France and Études et Recherches Hydrauliques d'Électricité, France). Compt. Rend., 256: 597-600(Jan. 14, 1963). (In French)

Density measurements of materials of great thickness by γ back scattering have the disadvantage that the total quantity of material does not interfere in a homogeneous fashion and the chemical composition is a parameter which cannot be neglected in the majority of cases. These two disadvantages are studied. The variation of the counting rate as a function of the height of one of two layers with widely separated density values was determined, and the results are shown graphically. The energy spectra obtained after back-scattering on sand and concrete are compared with the original spectrum of Cs^{137} to show the effects of the chemical composition. (J.S.R.)

14580 THE APPLICATION OF RADIOACTIVE SOURCES IN THE TEXTILE INDUSTRY. PART I. PRINCIPLES, MEASURING DEVICES AND METHODS. Adolf Heger. Faserforsch. Textiltech., 13: 183-93(Apr. 1962). (In German)

The physical basis of radioactivity, characteristics of various kinds of radiation, instruments and methods of radiation measurement, interaction of matter and radiation, and the use of radioisotopes from the viewpoint of the textile technician are discussed. (OID)

14581 THE APPLICATION OF RADIOACTIVE SOURCES IN THE TEXTILE INDUSTRY. PART II. PROBLEMS OF PROTECTION AGAINST RADIATION AND ASPECTS OF ORGANIZATION. Adolf Heger. Faserforsch. Textiltech., 13: 235-42(May 1962). (In German)

Detailed discussions are given on the dangers involved in handling radioactive substances, the biological effects of radiation, protective measures against radiation damage, the legislative basis of radiation protection in the GDR, the organization, administration, and practical application of personnel health protection in industrial plants using radioactive preparations. (OID)

14582 THE APPLICATION OF RADIOACTIVE RADIATION SOURCES IN THE TEXTILE INDUSTRY. PART III. DETERMINATION OF THICKNESS, DENSITY AND AREA WEIGHTS. Adolf Heger. Faserforsch. Textiltech., 13: 318-25(July 1962). (In German)

Two methods for measuring thickness or density of textiles by nuclear radiation are discussed: the absorption method, which is based on the characteristic attentuation of radiation passing through matter; and the second method, which is based on the characteristic backscattering of radiation. The most common radiation used in the textile industry is β radiation, which varies according to the thickness of the fibers and textiles. The most common β emitters used in the textile industry are C^{14}, S^{35}, Ca^{45}, Kr^{85}, Sr^{90}, Ru^{106}, Ce^{144}, Pm^{147}, and Tl^{206}. A newly developed absorption method, using the β radiation of Kr^{85}, is especially useful for determining not only the area weight, but also the humidity, homogeneity, and strength of fabrics in continuous operation. The type and degree of impregnation of textiles is also measurable. Calibration curves for cotton, wool, and nylon facilitate the detection of small differences. (P.C.H.)

14583 THE APPLICATION OF RADIOACTIVE RADIATION SOURCES IN THE TEXTILE INDUSTRY. PART IV. FURTHER EXAMPLES OF APPLICATION. Adolf Heger. Faserforsch. Textiltech., 13: 370-6(Aug. 1962). (In German)

A review on the status of radioisotope applications in the textile industry is presented. The use of energy-rich radiation for the initiation of block- and graft polymerization of macromolecules used in the manufacture of synthetic fibers is discussed. For determining the colorfastness of fabrics, their behavior toward fatty acids can be measured by using soaps or detergents labeled with I^{131}. In manufacturing viscose fibers, the complete removal of S can be determined by using S^{35}-labeled xanthogenate. The viscosity can be measured by determining the sink velocity of a radioactively labeled small Pb ball. In spinning, numerous applications are possible by using suitably labeled radioactive fibers in the spinning process. In weaving, radioisotopes allow the control of the physical and mechanical qualities of the fabrics. In laundry and dry-cleaning research, radioisotopes are used for determining the soil removal from different fabrics by various cleaning agents. Po^{210} is used in textile plants for removing static electricity accumulating in textile machinery during operation. (OID)

14584 GAMMA IRRADIATION INSTALLATIONS AND RESEARCH ON FOOD PRESERVATION AT THE BELGIAN CENTRE d'ETUDE DE l'ENERGIE NUCLEAIRE. M. De Proost. Food Irradiation, 2: No. 1, A2-A5(July-Sept. 1961).

Intensive studies were carried out on foodstuff sterilization involving radiological, bacteriological, and organoleptic tests; and the identification of the factors responsible for off-taste and off-flavor of irradiated food. The research was concerned mainly with various vegetables, especially potatoes, which can be prevented from germinating by low dosages of γ radiation. The radiation equipment used is described. (P.C.H.)

14585 FOOD PRESERVATION RESEARCH IN SWEDEN. L. E. Ericson. Food Irradiation, 2: No. 2, A2-A5 (Oct.-Dec. 1961).

A review of the research on the preservation of foodstuffs by radiation in Sweden is presented. Seven different research groups are presently engaged in this type of work. (P.C.H.)

14586 NEW DEVELOPMENTS IN THE FIELD OF RADIOACTIVE LUMINOUS PAINTS. [PART] I. Reinhold Wahl. Ind. Lackier-Betrieb, 30: 187-92(June 1962). (In German)

It was found that β-emitters, in contrast to α-emitters, have a less deleterious effect on luminous paints. β-emitters must meet several requirements in order to be used in manufacturing luminous paints: their half lives must be long enough to guarantee a sufficiently long period of usefulness; their prices must be reasonable so that the production of luminous paints is economically feasible; and their radiation charges must be low enough to reduce health hazards to a minimum. A study of all available β-emitters showed that only Pm^{147} and T met the requirements. (P.C.H.)

14587 NEW DEVELOPMENTS IN THE FIELD OF RADIOACTIVE LUMINOUS PAINTS. [PART] II. Reinhold Wahl. Ind. Lackier-Betrieb, 30: 228-30(July 1962). (In German)

The scientific principles of the luminous paint industry are discussed, including the nature of radioactivity, the discovery and occurrence of natural isotopes, and the subsequent production of artificial radioisotopes. The technology of manufacturing luminous paint includes the treatment of ZnS with small amounts of Cu in order to form luminous centers, the application of radioactive substances as activators, and the use of cementing material to convert the powdery phosphor into an applicable paint. Pm^{147} can be obtained by bombarding a Nd^{146} target with neutrons in the atomic reactor or it can be isolated from the fission products of U decomposition. (P.C.H.)

14588 NEW DEVELOPMENTS IN THE FIELD OF RADIOACTIVE LUMINOUS PAINTS. [PART] III. Reinhold Wahl. Ind. Lackier-Betrieb, 30: 274-6(Aug. 1962). (In German)

The biological effects of α, β, and γ radiation are discussed. Gamma radiation is considered as being emitted by impurities associated with the α and β emitters used in luminous paints. The most economical method for the production of T, which is used in luminous paints, consists of bombarding a Li target with slow neutrons in the nuclear reaction, $Li^6 + n \rightarrow T + He^4$. (P.C.H.)

14589 NEW DEVELOPMENTS IN THE FIELD OF RADIOACTIVE LUMINESCENT PAINTS. [PART] IV. Reinhold Wahl. Ind. Lackier-Betrieb, 30: 299-301(Sept. 1962). (In German)

The effects of α, β, and γ radiations on living organisms are discussed and classified into damages due to external radiation and damages due to the incorporation of radioactive material through inhalation or intake of contaminated food or drink. It is pointed out that a 0.5-mm thick plexiglass crystal can block off the β-rays of Pm^{147}, a radioisotope used frequently for the preparation of luminous paints. Gamma radiation is the most dangerous source of external radiation damage because of its great penetrating power. For this reason, in the manufacture of luminous paints, radiation sources are preferred which are similar to T, which is free of γ radiation. A discussion on the biological effect of radiation, which depends not only on the type and strength of the source but also on the sensitivity and exposure of the organism is also presented. (P.C.H.)

14590 DETERMINATION OF THE ASH CONTENT OF LIGNITE BY MEANS OF γ BACK SCATTERING. S. Koch and W. Liebig (Technische Universität, Dresden). Isotopen Tech., 2: 353-6(Dec. 1962). (In German)

A study was made to determine how the intensity of Tm^{170} γ radiation, scattered 135°, depends on the ash content of lignite. The measurements were made both on dried coal and crude lignite. As a result of the determination of

the effect of thickness, moisture, and grain size distribution on the measurement validity, it was possible to determine the limits of the method and the accuracy attainable. (tr-auth)

14591 THE PROBLEMS OF THE DETERMINATION OF THE ECONOMICAL UTILIZATION IN THE TECHNOLOGICAL INTRODUCTION OF NUCLEAR RADIATION. RESULTS IN THICKNESS AND DENSITY MEASUREMENT. H. Hart (Forschungsstelle für Technische Gasentladungen der DAW, Potsdam, Ger.). Isotopen Tech., 2: 373-80 (Dec. 1962). (In German)

The economic profits resulting from the utilization of radiation thickness and density gages are discussed with the purpose of directing the attention of economists to this area. Comparative values for industrial savings are given and discussed for the USA, Great Britain, and the USSR. (tr-auth)

14592 GAMMA-RAY STERILIZATION OF MEDICAL UTENSILS. Nature, 197: 134(Jan. 12, 1963).

A privately owned Cs^{60} irradiation plant is being used to sterilize disposable plastic syringes. The radioactive source emitting the sterilizing γ rays consists of 120 Cobalt rods, having a half life of five years, and a capacity of 50,000 curies. Gamma radiation provides the safest and surest means of assuring sterility. (H.G.G.)

14593 A RADIOACTIVE MARKING INK. J. E. Gardiner (Inst. of Basic Medical Sciences, Royal Coll. of Surgeons, London). Nature, 197: 414(Jan. 26, 1963).

A radioactive ink was prepared for use in marking paper chromatograms and x ray films to assist in realignment after the film is developed. A satisfactory ink was prepared using Pm^{147}. (C.H.)

14594 THE EFFECTS OF γ-IRRADIATION ON THE CAN MATERIALS AND VARIOUS CANNED FOODS. Toshiyuki Hirano, Takeaki Kikuchi, and Ikunosuke Okada. Tokyo Univ. Fisheries, 47: 296-304(Nov. 1961).

The effects of γ rays on can materials and various canned foods were investigated using boiled mackerel, seasoned tuna, smoked tuna in oil, mandarines in syrup, creamed sweetcorn, seasoned whale meat, smoked oysters, and boiled salmon, all canned in electrolytic tin plate, and irradiated with a total dosage of 5×10^5 r and 2×10^6 r from a 1000-C Co^{60} source; the average dosage rate being 6×10^4/hr. The foodstuffs and cans were examined after irradiation by organoleptic observations, ferroxyl tests, and polarographic determination. Off-flavors, color, or odor changes were not noted at dosages up to 5×10^5 r. However, a difference in irradiation effects between coated and uncoated cans was observed at a dosage level of 2×10^6 r by the ferroxyl and polarographic test. Of all constituents of the canned goods, salt, sugar, and citric acid showed the most unfavorable effects on the canning material during irradiation. It was concluded that irradiation preservation with 5×10^5 r for pasteurization and with 2×10^6 r for sterilization should be practicable because at these levels no damage occurred in the cans. (P.C.H.)

INSTRUMENTS AND INSTRUMENTATION

General and Miscellaneous

Refer also to abstracts 14469, 14933, and 15233.

14595 (HW-SA-2856) INFRARED INSTRUMENT FOR NONDESTRUCTIVE HEAT TRANSFER TESTING. D. R. Green (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 17, 1962. Contract AT (45-1)-1350. 25p.

An instrument is described in which an infrared radiometer is used to detect transient surface temperatures of test pieces during or after application of heat. Detected surface temperatures, which are higher in the vicinities of defects, are quantitatively mapped using either a helical area map, or a newly developed method which represents the temperature as lengths of line segments printed on a two dimensional field. A reflective technique is used to minimize the effect of emissivity differences on the test results. Although the Hanford heat transfer test was developed for application to cylindrical nuclear fuel elements, the techniques and concepts presented should be applicable to testing aircraft and missile components. (auth)

14596 (KAPL-902) THE CONVERSION OF THE CONSOLIDATED-NIER MASS SPECTROMETER TO A RECORDING, AUTOMATIC INSTRUMENT AND ITS APPLICATION TO CONTINUOUS SAMPLING AND ANALYSIS. H. C. Mattraw and R. E. Patterson (Knolls Atomic Power Lab., Schenectady, N. Y.). June 1, 1953. Contract W-31-109-eng-52. 25p.

Two types of automatic recycling mass-spectrometer scan systems are compared; the voltage scan system is shown to be more rapid but the magnetic scan system to be more desirable for the analysis of H isotopes and impurities. Data are presented which show that 4-ft lengths of 4-mil-ID tubing are preferred for continuous sampling of tritium process-gas streams. Since the machine is incapable of resolving the He^4 and HT peaks, separation of He and H_2 isotopes was accomplished with both charcoal and Pd beds. The use of a charcoal bed has advantages analytically. The use of the viscous leak for continuous sampling required calibration for various gas mixtures. It was shown that even with multicomponent mixtures, gas sensitivities are a function of the square root of the average molecular weight of the mixture. Once this was established there was no further need for preparing standard mixtures of the approximate composition of the analytical sample. (auth)

14597 (NAA-SR-Memo-7403) DYNAMIC VOID FRACTION DETECTOR. J. H. Kendron (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 21, 1962. Contract [AT(11-1)-Gen-8]. 39p.

Various methods and techniques for measurement of void fraction are discussed. Abstracted details of seventeen void fraction detectors are tabulated. A dynamic detector, which measures void fraction and void fraction distribution in a 12-ft-long, ½-in.-dia. Ni test section filled with Santowax-R coolant, is described. Void fraction is determined by measurement of the intensity of a narrow x-ray beam which penetrates the test section. A high intensity, low energy, x-ray generator, scintillation detectors, and a wide band–fast response amplifier are used for detection of rapid void fraction transients. Major sources of error are cancelled by using two detectors connected in a differential circuit. Serial cooling and heavy magnetic shielding of the detectors further reduce measurement errors. The void fraction detection system is mounted on an elevator assembly which is used for vertical and horizontal scans of the test section. (auth)

14598 (NP-12593) DESIGN OF A QUADRUPOLE MASS SPECTROMETER. Technical Report 176. C. E. Woodward and C. K. Crawford (Massachusetts Inst. of Tech., Cambridge. Lab. for Insulation Research). Jan. 1963. Contracts AF33(616)-8353 and Nonr-1841(10). 31p.

A mass spectrometer using an electric-quadrupole mass filter has been designed and built to cover 1 to 400 amu in four ranges. The r-f drive voltages for the quadrupole filter are obtained from a Class C amplifier with feedback-controlled modulation. The d-c voltages are obtained from feedback-controlled amplifiers. Provisions are made for rapidly sweeping the mass range by changing the r-f and d-c voltages and for oscillographic presentation of the spectra. It is found that a suitable relation between applied r-f and d-c voltages can make spectral line widths and filter transmission independent of mass. Apparatus built, but not yet completely operational, will produce a single output pulse of standard size for each ion incident on the electron-multiplier ion detector; integration of these pulses gives a current proportional to the rate of ion impacts but independent of electron-multiplier gain fluctuations. The spectrometer is found to have a maximum resolution of about 700; maximum resolution at unity transmission is about 30. The lowest pressure it can detect at present is about 10^{-10} torr. There is a fine structure on the peaks of the mass spectrum that is dependent upon the transverse momentum of the ions entering the quadrupole. (auth)

14599 (NRL-5807) OPERATIONAL PERFORMANCE OF THE NRL THERMISTOR-BRIDGE GAS LEAK DETECTOR AND ITS SENSITIVITY TO VARIOUS GASES. P. T. Stine and R. E. Koncen (Naval Research Lab., Washington, D. C.). May 29, 1962. 22p. (AD-277410)

The thermistor-bridge gas leak detector is a portable electronic device useful for location of leaks from pressurized systems containing any gas having a thermal conductivity different from that of the ambient air. Operational experience with the device as used aboard nuclear submarines indicates that the design is useful and very reliable. Although the gas leak detector is designed as a qualitative device not intended for quantitative measurements, knowledge of its approximate sensitivity to various gases is useful in providing some idea of size and seriousness of a leak. A method is presented for predicting relative sensitivity based upon diffusivity and thermal conductivity. Sensitivity of the device to selected gases is measured in the laboratory and correlated with predicted sensitivities. With the exception of oxygen and nitrogen, which have thermal conductivities very near that of air, results correlate within a factor of two, indicating that the method is adequate for rough prediction, keeping in mind that sensitivity is also a function of operator technique. (auth)

14600 (NYO-10010) ULTRASONIC INSTRUMENTATION IN NUCLEAR APPLICATIONS. I. ULTRASONIC DETECTION OF INCIPIENT BOILING AND CAVITATION. Carmine F. DePrisco, Herbert Kartluke, Nicholas Maropis,

and William B. Tarpley (Aeroprojects Inc., West Chester, Penna.). Mar. 1962. Contract AT(30-1)-1836. 20p.

A means for anticipating incipient boiling in pressurized water reactors is described. Cavitation at a small probe face is induced by ultrasonic vibration, the power required being a function of the local vapor pressure deficit from the boiling condition. A cavitation noise response is sensed and transmitted along an acoustic coupler, converted into electrical impulses and observed on a cathode ray tube or utilized to activate warning or control devices. Conceptual designs for coupler arrays suitable for entry into the high-pressure, high-radiation environment are presented. Detection of cavitation, at temperatures up to 155°C and at pressures up to 5.7 atmospheres, is reported. (auth)

14601 (NYO-10011) ULTRASONIC INSTRUMENTATION IN NUCLEAR APPLICATION: II. DETERMINATION OF HEIGHT AND LIQUID CONTENT OF FOAM. Carmine F. DePrisco, Herbert Kartluke, Nicholas Maropis, and William B. Tarpley (Aeroprojects, Inc., West Chester, Penna.). Apr. 1962. Contract AT(30-1)-1836. 17p.

The direct use of steam from boiling water reactors requires the control of phase interface levels, especially the level of the steam foam interface. A method for locating the levels of the interfaces between steam foam, and boiling water by application of ultrasonic load impedance principles is shown. The liquid content of both actual boiling water foams and stabilized simulated types, varying in water content from 0.8 to 25 vol % was so determined. The feasibility of making such measurements ultrasonically in nuclear equipment through the use of unique hermetically sealable force-insensitive mounts is illustrated by conceptual design considerations. The direction of further design improvement, for additional sensitivity, is shown. (auth)

14602 (NYO-10012) ULTRASONIC INSTRUMENTATION IN NUCLEAR APPLICATIONS: III. CONTINUOUS DETERMINATION OF SOLID PARTICLE CONTENT IN LIQUID SLURRIES. Carmine F. DePrisco, Herbert Kartluke, Nicholas Maropis, and William B. Tarpley (Aeroprojects, Inc., West Chester, Penna.). Apr. 1962. Contract AT(30-1)-1836. 30p.

Nuclear reactors, using particulate slurries as fuel or blanket, require rapid detection of changes in particle size or concentration for stabilizing controls. Ultrasonic probe instrumentation is one means of estimating these changes. Furthermore, the availability of hermetically sealable force-insensitive mounts will permit the use of such probes in nuclear reactor environment with remote transducer and read-out instrumentation. The measurement of acoustic properties (at ultrasonic frequencies) of solid suspensoid systems appears to indicate that variations in particle concentration can be determined from changes in either impedance ratio or sound attenuation over the range of concentrations studied (300 to 1000 g/l). The variation of sound attenuation as a function of particle size was measured and extinction coefficients were determined for 3-, 15-, and 40-micron particles. Impedance ratio measurements also indicate a relation between the particle size and acoustic properties of their suspensions. (auth)

14603 (NYO-10077) RESEARCH AND DEVELOPMENT OF A LARGE DEMAGNIFYING IMAGE INTENSIFIER. Quarterly Progress Report, January–March 1962. D. DesRochers (Radio Corp. of America, Camden, N. J.). Apr. 17, 1962. Contract AT(30-1)-2840. 11p.

A two-stage image intensifier, RCA C70062, is developed for intensification of nuclear tracks in large scintillation chambers. The first demagnifying stage has an S-20 photocathode on a 0.040-in.-thick, eight-in.-dia. glass faceplate. Fiber optics couples the short decay P15 phosphor of the first-stage to the cathode of the second-stage, which has a shutter grid for low voltage gating. The output screen is a one-in.-dia. P11. Parts were made and assemblies were started. (auth)

14604 (NYO-10078) RESEARCH AND DEVELOPMENT OF A LARGE DEMAGNIFYING IMAGE INTENSIFIER. Quarterly Progress Report No. 3, April 1, 1962–June 30, 1962. R. D. DesRochers and A. L. Morehead (Radio Corp. of America. Electron Tube Div., Lancaster, Penna.). July 13, 1962. Contract AT(30-1)-2840. 11p.

The operation of the shutter stage of the C70062, a large demagnifying image intensifier, was tested. With an overall voltage of 14 kv, the first grid at ground potential, and the second grid at 325 v, the cathode is used as control electrode. The image is in focus for a cathode potential of 125 v above ground, and cuts off at 425 v. The 300 v swing produces even cut-off without spurious light. The tube has a center resolution of 18 line pairs per mm at the center of the cathode, and a resolution of 16 line pairs per mm 13 mm from the center. The magnification is 0.6. An ultimate pressure of 6×10^{-9} torr at tip-off was obtained by exhausting the tube with a 140 l/sec Vac-Ion Pump. (auth)

14605 (NYO-10079) RESEARCH AND DEVELOPMENT OF A LARGE DEMAGNIFYING IMAGE INTENSIFIER. Final Report, July 1, 1961–September 30, 1962. R. [D.] DesRochers and A. L. Morehead (Radio Corp. of America. Electron Tube Div., Lancaster, Penna.). Nov. 5, 1962. Contract AT(30-1)-2840. 27p.

A two-stage nuclear track image intensifier (RCA Tube Type C70062) was developed for use with large fiber scintillation chambers. The first stage has an 8-in.-dia. S-20 photocathode on a curved 0.040 in.-thick glass faceplate for direct optical coupling to the scintillation chamber. The demagnified image is stored on a short decay P-15 phosphor and transmitted by fiber optics to the S-20 photocathodes of the second intensifier stage. This stage has a shutter aperture (no grid wires) that can be gated from "off" to "on" with a pulse of only 400 volts, to transmit the track image to the final 3-in.-dia. P11 screen. The quantum gain can exceed 200, and, with a demagnification of $\frac{1}{6}$ and 3% linear distortion, a fiber of 1 mm on the first cathode can be resolved on the screen. (auth)

14606 (ORNL-3378) INSTRUMENTATION AND CONTROLS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 1, 1962. (Oak Ridge National Lab., Tenn.). Feb. 6, 1963. Contract W-7405-eng-26. 102p.

Progress is reported on instrumentation and controls. Topics covered include: electronic systems and components, semiconductor research, radiation monitoring systems, radiation-detection instruments and components, data handling and computation, process instrumentation and control systems, process instrumentation development, reactor instrumentation and controls, and support for high-voltage accelerator program. Separate abstracts were prepared for each topic. (M.C.G.)

14607 (ORNL-3378(p.1-17)) ELECTRONIC SYSTEMS AND COMPONENTS. (Oak Ridge National Lab., Tenn.).

Nanosecond circuitry and conventional instrumentation systems were developed for obtaining data on the physics of high-energy protons in shielding studies. Applications to the Apollo program are described. A system for remote

control of the Oak Ridge Isochronous Cyclotron and experimental facilities was installed in order to reduce radiation-exposure hazards and to make full use of the flexibility designed into the facility. An investigation was begun to determine a method of gating a photomultiplier tube during a relatively intense radiation on the scintillator to prevent the amplifiers that follow the photomultiplier from becoming overloaded. A circuit that accepts four input signals of either polarity and an input signal from a 400-channel analyzer was designed. A system was designed that permits measurement of the scintillation response of CsI (Tl) crystals at 1, 4, 7, 10, and 15 μsec after the crystal was excited. (M.C.G.)

14608 (ORNL-3378(p.18-21)) SEMICONDUCTOR RESEARCH. (Oak Ridge National Lab., Tenn.).

Studies showed that the breakdown of a surface barrier almost invariably occurs at the edge of the junction and that the breakdown voltage can be increased nearly one order of magnitude appropriate control of the surface chemistry of the silicon. By careful exclusion of ammonia compounds and water from the edge of the silicon-to-gold junction, the silicon surface charge distribution near this edge was modified in a manner such as to permit continued operation in the kilovolt range. Such modified edges were sources of electrical noise, but it was possible to suppress this edge noise with the guard-ring structure. Detectors of this type were operated over 1800 v, with resulting barrier depths up to $1\frac{1}{2}$ mm. (M.C.G.)

14609 (ORNL-3378(p.22-7)) RADIATION MONITORING SYSTEMS. (Oak Ridge National Lab., Tenn.).

Expansion and modernization of the radiation monitoring systems at ORNL are described. The status of installation of instrumentation for the containment program of the Laboratory is summarized. A radiation monitoring system was designed to protect personnel in the vicinity of the tandem Van de Graaff accelerator from receiving more than a specified integrated dose rate based on an 8-hr period. (M.C.G.)

14610 (ORNL-3378(p.28-36)) RADIATION-DETECTION INSTRUMENTS AND COMPONENTS. (Oak Ridge National Lab., Tenn.).

A transistorized monitor for beta-gamma or alpha radiation was designed and is being tested to determine whether the savings realized from a lower failure rate of the transistorized instrument make it more economical than a comparable vacuum-tube instrument even though its initial cost is higher. Two identical constant air monitors were installed in adjacent laboratories, and the difference in the count rate of the two monitors was measured by a difference monitor. The difference monitor was set to alarm at a difference of 250 counts/min, whereas a single monitor was set to alarm at 1250 counts/min to avoid alarms when temperature inversion occurred. An experimental model of the aerial monitor was modified to make it easier for the pilot to operate and observe the instrument while flying the airplane. A shelter monitor was also developed for civil defense use. The full-scale ranges of this instrument when used with the explosion-proof chamber designed for this use are 1, 10, 100, and 1000 r/hr. A portable 12-v scaler was designed for surveying low-level radioactivity by river-survey teams. It is also useful for surveying ground surfaces. A neutron monitor was developed to monitor either fast or thermal neutrons in a low background. Studies were continued to develop a monitor which measures at a remote point the power or gamma flux, or both, in the central region of the reactor lattice. A high-current biplanar phototube was tested at the porthole of the ORR. Output current vs reactor power gave a replica of the curve previously obtained with a silicon solar cell. A scintillation-type alpha counter for counting smear samples was developed to produce an instrument having a lower fabrication cost than commercially designed units. A crystal-controlled pulse generator was designed for checking the calibration of linear and logarithmic count-rate meters. A high-voltage supply having an output of 500 to 1400 v was designed. A power-supply regulator circuit was designed that permits construction of any one of 24 supplies. The cost of the standard fast-neutron counter with a built-in alpha source was reduced by redesigning the counter. The cost of the windowless flow-proportional counter was also reduced by redesign. (M.C.G.)

14611 (ORNL-3378(p.37-43)) DATA HANDLING AND COMPUTATION. (Oak Ridge National Lab., Tenn.).

A data-collection system was developed for determination of the acceleration and velocity of a control rod vs its position. The system consists of a magnetic-tape transport and control, a shaft-position digitizer and translator, and a test selector and control unit. Criteria were developed and specifications were prepared for a digital data-collecting and computing system to be purchased for the Molten-Salt Reactor Experiment. (M.C.G.)

14612 (ORNL-3378(p.44-6)) PROCESS INSTRUMENTATION AND CONTROL SYSTEMS. (Oak Ridge National Lab., Tenn.).

Process instruments and controls were extensively reworked and new instruments added in the Volatility Pilot Plant. Process and radiological instrumentation design criteria are being prepared for the Transuranium Processing Facility. Many process-measurement and control instruments for ORNL operating reactors were redesigned and renovated to improve the operating efficiency and reliability. (M.C.G.)

14613 (ORNL-3378(p.47-62)) PROCESS INSTRUMENTATION DEVELOPMENT. (Oak Ridge National Lab., Tenn.).

Stainless steel nozzles were tested for up to 500 hr of continuous operation. After 150 hr of high-temperature operation, the flow coefficients shifted in value. Nozzles formed in cemented carbides were brazed into stainless steel holders with a copper and a nickel–palladium alloy. Neither alloy gave an acceptable bond. A miniature probe was fabricated and tested. A control panel for the calorimeter was designed and fabricated and is being used with another calorimeter. An oil bath for housing the entire calorimeter, adiabatic shield, and vacuum-jacket assembly was designed. Instruments were supplied for testing the physical ruggedness of radioisotope transportation casks. The casks were dropped from various heights at different angles of impact. A highly accurate, direct-readout system was developed for the precise measurement of the viscosity of molten salts by the torsional pendulum method. Designs of separators were studied to determine their efficiency in separating up to 100 ppm of 2μ-diam graphite particles from in-line samples of the EGCR helium coolant stream. A device was designed, constructed, and installed to collect samples of gas from the vicinity of the underground Project Gnome nuclear explosion within 10 sec after the detonation. No samples were obtained because the pipe that was to carry the gas to the sampler was ruptured. A stable millivolt reference supply previously developed was improved by increasing the accuracy of the dial setting. Conductivity-type probes are being developed for deter-

mining levels of molten salt. A system was developed to monitor and display the signals from approximately 420 thermocouples. (M.C.G.)

14614 (ORNL-3378(p.63-79)) REACTOR INSTRUMENTATION AND CONTROLS. (Oak Ridge National Lab., Tenn.).

Development of second-generation ORNL reactor control instruments was continued. Two types of gamma-sensitive ionization chambers for reactor control and safety were developed. Activities of the operating reactors section are reported. Design of the process instrumentation for the Molten Salt Reactor Experiment is nearing completion and design of the nuclear instrumentation system is under way. (M.C.G.)

14615 (ORNL-3378(p.80-93)) SUPPORT FOR THE HIGH-VOLTAGE ACCELERATOR PROGRAM. (Oak Ridge National Lab., Tenn.).

The 12-Mev tandem Van de Graaff was accepted for experimental use in March 1962. Proton beams up to 12 Mev and heavy-ion beams up to 42 Mev were produced with energy resolution better than 0.1%. A charge-current regulator was developed for the 5-Mev Van de Graaff to stabilize and automatically adjust the belt charge currents for changes in operating conditions. The duoplasmatron ion source and pulser were operated over 1200 hr in the ORNL 3-Mev Van de Graaff Accelerator. The beam-pulse pickoff system for this accelerator was replaced with an improved system that includes a two-stage fast-rise-time transistor amplifier. A klystron buncher was installed in the terminal to produce a bunch factor of >10 for beam energies up to 1 Mev. (M.C.G.)

14616 (TID-18103) REACTOR CORE THERMAL INSTRUMENTATION. D. A. Lampe (Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C.). July 6, 1960. Contract [AT(10-1)-925]. 37p. (EGCR-STUDY-II-127)

A detailed report on a study to select the location and design of sensors and leads for non-nuclear instrumentation in the reactor core as per previously defined specifications is presented. Sketches of required thermal instrumentation are included. (H.G.G.)

14617 (AEC-tr-5670) A NEW MASS SPECTROMETER WITHOUT A MAGNETIC FIELD. Paul Von Wolfgang and Helmut Steinwedel. Translated for Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex. from Z. Naturforsch., 8a: 448-50(1953). 6p.

A mass spectrometer, which employs only a quasi-stationary alternating electric field for which the magnitude of the field strength is proportional to the distance from a fixed straight line, i.e., the z-axis, is described. (H.G.G.)

14618 (AEC-tr-5675) REFERENCE ELECTRODES FOR HIGH TEMPERATURES. G. Danner and M. Rey. Translated from Electrochim. Acta, 4: 274-87(1961). 22p.

Results of investigations on reference electrodes in molten systems are described. Development of electrodes that are easy to handle and with sufficient precision for temperatures ≤960°C is discussed. Results at higher temperatures are encouraging, but only the first step in solving the problem. (auth)

14619 USE RASTER OSCILLOSCOPES FOR FASTER TIME MEASUREMENTS. Richard P. Rufer and William A. Karlotski (Univ. of California, Livermore). Electronics, 35: 5p.(Dec. 28, 1962). (UCRL-6982)

A transistor raster oscilloscope is described for displaying high-resolution time-interval measurements. The oscilloscope uses TV-type scanning and a crt face, and its power consumption is only 100 watts. The sweep circuits are described in detail. (D.L.C.)

14620 PROTON RESONANCE FIELD REGULATOR FOR DIFFERENT ELECTROMAGNETS. A. E. Schwind. Exptl. Tech. Physik, No. 5, 323-34(1962).

A proton resonance field regulator is described which can be installed on electromagnets with variable time constants for precise stabilization of the magnetic field. Its regulating procedure is adjusted with the time constant of the magnet by varying the built-in phase correcting unit in the regulator. By inserting a magnetic current stabilizer into the controlling loop, the correction coil becomes unnecessary and, therefore, it is easier to assemble and disassemble the proton-resonance-regulator. When only the magnet and the current stabilizer operated, the relative field stability reached $1 \cdot 10^{-4}$ for several hr. When a proton-resonance regulator was added, the measured relative field stability on a multipurpose magnet at a linear width of the nuclear resonance signal of 0.2 Gauss reached $1 \cdot 10^{-6}$ for 4 hr. (OTS)

14621 A NEW PHOTOMULTIPLIER FOR THE MEASUREMENT OF LIGHT PULSE INTERVALS IN THE NANOSECOND RANGE. P. Goerlich, A. Krohs, and H.-J. Pohl. Exptl. Tech. Physik, 10: 247-55(1962). (In German)

A new series-connected nanosecond multiplier (type symbol K 14 FS 50) is presented, and the development principles used are briefly reported. Its properties with respect to its time resolution are indicated. (tr-auth)

14622 APPLICATION OF A NOISELESS BALLISTIC PULSE AMPLIFIER FOR THE MEASUREMENT OF THE SECONDARY ELECTRON EMISSION FROM INSULATORS. Bernhard Petzel (Deutsche Akademie der Wissenschaften, Berlin). Exptl. Tech. Physik, 10: 309-12(1962). (In German)

For the measurement of the secondary electron emission from insulators, a noiseless ballistic amplifier was developed, and its construction is briefly described using a circuit diagram. The tube E 88 CC with operating conditions specially adapted for its application was used for the input tube. At a total capacity C = 30 pF at the amplification input and a signal-noise ratio $\beta = 40$, the amplifier has a charge sensitivity $Q_{min} = 2 \times 10^{-15}$ amp-sec. (tr-auth)

14623 A VENETIAN BLIND TYPE DYNODE FOR CHANNELLED MULTIPLIERS WITH FAST TIME RESPONSE. R. Kalibjian (Univ. of California, Livermore). J. Sci. Instr., 39: 535-6(Oct. 1962). (UCRL-7005)

A Venetian blind-type dynode was developed for use in a cathode-ray switch tube with 11 channels of electron multiplication. The dynode has a rise time of 2 nsec for the output current pulse and less than 5% crosstalk to the channels adjacent to the one being scanned with an electron beam. A point-to-point plot of the trajectories from the departure dynode to the arrival dynode is given. (D.L.C.)

14624 CALIBRATION PULSE GENERATOR. J. Dubrau. Nachrichtentechnik, No. 4, 147-51(1962).

A calibration pulse generator, which generates rectangular pulses with amplitudes from 100 mv to 100 v with an accuracy of 1% is described. The temporary stability of the output amplitude is 2×10^{-4}. A built-in multivibrator generates rectangular oscillations at 24 or 95 cycles as well as rectangular pulses of 200 μs, at a repetition rate of 49 cycles. The pulse repetitions can be synchronized with the power-line frequency. Keying of the output stage is possible

by means of external pulse generators. The keying pulses must have a voltage of 36 v. Amplitude variations of the keying pulses of ±10% result in output amplitude variations of $\pm 1 \times 10^{-4}$. (O.T.S.)

14625 CHARACTERISTICS AND APPLICATIONS OF A LIQUID LEVEL MEASURING COUNTER. Tatsusaburo Suzuki (Ground Self Defense Force, Japan) and Tatsuo Urai. Nippon Genshiryoku Gakkaishi, 5: 22-9(Jan. 1963). (In English)

Some fundamental experiments were carried out for making precise measurements of the liquid level contained in a high pressure pipe by means of γ rays from radioactive substances and a G-M counter. γ rays from the radioactive source are sharply collimated by a wolfram slit and projected on the counter tube across the pipe. In order to increase the difference in the numbers of counts depending on whether the γ rays pass under the liquid surface or above, it is desirable to make the counting efficiency of the tube as large as possible. A wolfram block was inserted in the counter tube to improve the counting efficiency, and the liquid level in a steel pipe (thickness 35 mm, inside diameter 40 mm) was successfully measured with the experimental error less than 1 mm. Characteristics and counting efficiency at the different parts of the counter tube containing a wolfram block were also studied and the divergency of γ rays (0.662 Mev) from a slit of 0.08 mm width was measured. (auth)

14626 A SIMPLE TRANSISTORIZED FAST AC DISCRIMINATOR. S. Rozen and E. Altman (Atomic Energy Commission, Tel-Aviv, Israel). Nucl. Instr. Methods, 17: 337-41(Dec. 1962). (In English)

A simple transistorized pulse-height discriminator is described that is free from retriggering effects and has good linearity and threshold stability. It consists of a conventional diode-discriminator followed by a sensitive univibrator. The circuit is designed to discriminate positive pulses only, but the addition of a highly degenerated inverter of wide dynamic range permits the discrimination of negative pulses as well. (auth)

14627 APPLICATION OF PULSE TRANSFORMERS IN RAPID ELECTRONIC PULSE ANALYSIS. S. Gorodetsky, A. Muser, J. Zen, and R. Armbruster (Institut de Recherches Nucleaires, Strasbourg). Nucl. Instr. Methods, 17: 353-60(Dec. 1962). (In French)

Several transmission-line nanosecond-pulse transformers and their principle of operation are described. Their rise and decay time response are treated. Typical applications, specially a fast window discriminator and a linear gate, are given. (auth)

14628 BIBLIOGRAPHICAL REVIEW OF THE METHODS OF MEASURING MAGNETIC FIELDS. C. Germain (CERN, Geneva). Nucl. Instr. Methods, 21: 17-46(Jan. 1963). (In English)

This paper consists of two parts: first the introduction to the bibliography where the principles of most of the usual methods of measuring magnetic fields are presented together with their domain of application; the accuracy attained and the present limitations of each method are given. The second part is a list of about 280 references which are classified in chronological order under the heading of each particular method. (auth)

14629 DETERMINATION OF THE OPTIMUM WORKING CONDITIONS OF PHOTOMULTIPLIERS. G. Bellettini (Istituto Nazionale di Fisica Nucleare, Pisa, Italy), C. Bemporad, C. Cerri, and L. Foà. Nucl. Instr. Methods, 21: 106-12(Jan. 1963). (In English)

The effects of varying independently the inter-dynode voltages of Philips photomultipliers types 56 AVP and 58 AVP on the linearity and maximum gain obtainable are described. It is found that great improvements are possible over the performances obtainable with the voltage distributions recommended by the manufacturers and that with voltage distributions optimized separately for each tube it is always possible to at least achieve the maximum performances claimed by the manufacturers. The distributions recommended by them do not fulfill these claims. (auth)

14630 TIME MEASUREMENTS IN THE NANOSECOND REGION WITH THE CATHODE-RAY TUBE E80T. D. Bloess, A. Krusche, F. Muennich, and W. Oetzmann (Technische Hochschule, Braunschweig, Ger.). Nucl. Instr. Methods, 21: 113-20(Jan. 1963). (In German)

The application of the cathode-ray-tube E80T in time-to-pulse-height converters (TPC) for time measurements in the nanosecond region is discussed. Several variants of circuits are described and compared with each other. It is shown that the TPC can easily be adjusted to the different problems encountered in the measurement of very short times. As an example for the potentialities of application of the TPC the known lifetimes of two excited nuclear levels (80 kev level of Ba^{133} and 145 kev level of Pr^{141}) were measured with satisfying result. (auth)

14631 MAGNETIC FIELD DISTRIBUTION FOR WEAK-, STRONG- AND FFAG-FOCUSING PARTICLE ACCELERATORS AND OTHER NUCLEAR INSTRUMENTS. C. C. Iliescu (Inst. for Atomic Physics, Bucharest). Nucl. Instr. Methods, 21: 136-44(Jan. 1963). (In English)

For the magnetic guiding field of the weak-, strong-, and FFAG-focusing nuclear instruments used in the acceleration or dispersion of charged particles, general analytic expressions, valid for any point of the magnet gap, are derived concerning the following parameters: magnetic scalar potential, magnetic induction, and magnetic vector potential. These expressions are useful for the study of particle motion as well as for pole face design. (auth)

14632 IDEAL POLE FACES FOR WEAK-, STRONG-, AND FFAG-FOCUSING PARTICLE ACCELERATORS AND OTHER NUCLEAR INSTRUMENTS. C. C. Iliescu (Inst. for Atomic Physics, Bucharest). Nucl. Instr. Methods, 21: 145-54(Jan. 1963). (In English)

For the weak-, strong- and FFAG-focusing magnets of particle accelerators and other nuclear instruments (particle spectrometers, deflectors, electromagnetic isotope separators, etc.) the concept of ideal pole face is introduced by neglecting saturation, remanence and edge effects. From the analytic expression of the magnetic scalar potential, derived for a general case, the equation of the ideal pole face is deduced and applied to weak-, strong- and FFAG-focusing magnets. For FFAG nuclear instruments with spiral sectors an ideal pole face is derived from a fundamental pole face with cylindrical symmetry, modified to obtain the azimuthal variation of the magnetic guiding field. The actual pole face can be computed from the ideal one if the edge effects are taken into account. General analytic expressions of the equipotential set and potential network, useful for this computation, are deduced. (auth)

14633 100-FOIL SAMPLE CHANGER WITH TAPE-CONTROLLED SEQUENCING. Curtis G. Chezem and Herbert H. Helmick (Los Alamos Scientific Lab., N. Mex.). Nucleonics, 21: No. 3, 83(Mar. 1963).

Conversion of a juke box into a foil changer that stores 100 foils and changes them according to a pre-selected,

tape-controlled sequence in 10-23 sec depending on how far the storage basket must rotate to index the sample is described. (D.C.W.)

14634 ELECTRONICS ASSOCIATED WITH MEASUREMENT INSTRUMENTS. G. I. Alon (Ecole Normale Supérieure, France). Onde Elec., No. 421, 24p.(Apr. 1962). (In French)

For the complete study of the magnetic properties of electromagnets, a group of devices were developed which permitted the measurement of the induction in magnitude and direction and the control and the current through the coils. In the particular conditions of use, the induction measurement does not disturb the electron beam. The design and characteristics of a device for magnetic field measurements, a device for the control of the intensity and induction of magnetic spectrometers, electrometer current integrators, and a scaler are presented in detail. (J.S.R.)

14635 RADIO-FREQUENCY BRIDGE FOR PULSED NUCLEAR MAGNETIC RESONANCE. Irving J. Lowe (Univ. of Pittsburgh) and Dennis E. Barnaal. Rev. Sci. Instr., 34: 143-6(Feb. 1963).

A symmetrical r-f bridge for pulsed nuclear magnetic resonance experiments is described. The bridge is nonmicrophonic and permits the quick damping of the transients from r-f driving pulses without the degrading of free induction decay signals. (auth)

14636 100-Mc DIGITRON—A DIGITAL TIME ANALYZER. R. A. Lundy (Univ. of Chicago). Rev. Sci. Instr., 34: 146-9(Feb. 1963).

An instrument is described which measures microsecond time intervals by counting pulses from a 100-Mc CW oscillator; a commercially available scaler is employed as the major component. The over-all differential nonlinearity of the instrument is $\leq 10^{-2}$. Data are stored in a magnetic core memory. The deadtime associated with measurement and storage is minimized to permit use in experiments with pulsed accelerators. (auth)

14637 MULTIPLE-GAP MAGNETIC SPECTROGRAPH FOR CHARGED-PARTICLE STUDIES. H. A. Enge and W. W. Buechner (Massachusetts Inst. of Tech., Cambridge). Rev. Sci. Instr., 34: 155-62(Feb. 1963).

A spectrograph was designed that simultaneously records broad-range, charged-particle spectra at twenty-four different reaction angles, 7.5° apart, from 0 to 172.5°. At each angle, the spectrograph records a spectrum with a total energy range of about 2.3:1 and with a resolving power exceeding $R = E/\Delta E = 1000$, where ΔE is the full width at half-maximum of a peak. The recorders are seventy-two 2 × 10 in. nuclear-track plates, which are developed and scanned under a microscope after the exposures. When half-millimeter strips across the nuclear-track plates are scanned, the information contained on the nuclear-track plates after one exposure corresponds to about 36,000 data points. A typical exposure time with about a 0.5-μa beam is of the order of 2 to 3 hr. (auth)

14638 PRECISION OF FIXED-TIME VS. FIXED-COUNT MEASUREMENTS. D. W. Gaylor (General Electric Co., Pleasanton, Calif.). Anal. Chem., 34: 1670-1 (Nov. 1962).

Since I_s is generally much larger than I_B, the fixed-count procedure requires much more time to count background than to count the sample. An examination of the variance shows that a large amount of time, t'_B, is spent reducing the smaller component of the variance, I_B/t'_B. This time is better spent in reducing the larger component of variance, I_s/t'_s. It was proved that the variance of the fixed-time method is always less than or equal to the variance of the fixed-count method for any given total counting time ($t_s + t_B = t'_s + t'_B$). Conversely, for a specified precision, the expected total counting time required for the fixed-time method will be less than or equal to the expected total counting time required for the fixed-count method. (auth)

14639 HIGH POWER ELECTRONICS. P. L. Kapitsa. Usp. Fiz. Nauk, 78: 181-265(Oct. 1962). (In Russian)

First, the equations governing the motion of electrons in electric and magnetic fields are reviewed. These are then applied to the design of various high frequency power devices such as the magnetron and planotron (a flat magnetron). Experimental work on the planotron is given in considerable detail, including diagrams of construction, and photographs of the apparatus. A section is devoted to a review of the Larmor motion of electrons, and its importance in the two devices mentioned above. Some speculations are made about the possibility of power transmission by high-frequency electromagnetic radiation, and its conversion at the receiving end into useful forms of energy. (TTT)

14640 THEORY OF A GRAVITY NEUTRON REFRACTOMETER FOR THE ABSOLUTE DETERMINATION OF COHERENT SCATTERING CROSS SECTIONS. Heinz Maier-Leibnitz (Technische Hochschule, Munich). Z. Angew Phys., 14: 738-40(Dec. 1962). (In German)

A total reflection refractometer in which neutrons emerging almost horizontally from a slit, falling with gravity, hit a liquid mirror with a level that is accurately controllable with respect to the slit height is described. A sharp limitation of the total reflection, which in general is independent of neutron velocity, is given by altering the height difference. From the critical height difference, an absolute determination of the mean coherent scattering length of the liquid results. Dimensions, intensity, and accuracy of the instrument were discussed. (tr-auth)

Radiation Detection

Refer also to abstracts 14564, 14565, 14566, 15056, 15235, 15251, and 15287.

14641 (AEEW-M-268) A SIMPLE CALIBRATION JIG FOR THE MONITOR TYPE 1349. K. E. G. Perry and E. George (United Kingdom Atomic Energy Authority Reactor Group. Atomic Energy Research Establishment, Winfrith, Dorset, England). Oct. 1962. 11p.

A description is given of a jig for checking the operation and calibration of the least sensitive ranges of the Portable Dose Rate Meters type 1349 and 1400. The jig utilizes a Sr^{90} ($+Y^{90}$) source to produce the radiation field. The external radiation from the jig is low enough to permit its use in most operational areas without affecting normal measurements. (auth)

14642 (AEEW-M-281) LECTURE NOTES ON RADIATION DETECTION. A. Goodings and D. L. Roberts (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Sept. 1962. 58p. (RS/L 16)

A series of lectures are presented on the principles of radiation detection and the construction and choice of radiation detectors for reactors. The following types of detectors are described: gas counters, semiconductors, scintillators, fission devices, and boron devices. (D.L.C.)

14643 (AEEW-R-170) A NEW REACTOR LOG. POWER AND PERIOD METER. E. P. Fowler (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Nov. 1962. 46p.

A new reactor period meter was developed as part of a range of transistorized nucleonic instruments. The object was to produce an instrument that overcomes most of the shortcomings in performance of conventional period meters. It comprises a logarithmic amplifier covering eight decades of ionization chamber current, a differentiating amplifier, and HT polarizing supply for the chamber. Output from the log amplifier is shown on a single scale calibrated logarithmically while the reactor period is displayed on a meter scaled in "doubling time." The instrument has a better performance, greater range, and safer operation than previous period meters and is a forward step in the design of new reactor control instruments. (auth)

14644 (BNL-6827) A LINEAR IONIZATION CHAMBER FOR THE COSMOTRON. Internal Report. Gerald S. Levine and C. E. Swartz (Brookhaven National Lab., Upton, N. Y.). Mar. 11, 1963. Contract [AT(30-2)-Gen-16]. 4p.

An ionization chamber with linear response for measuring the intensity of external proton beams from the Cosmotron is briefly described, and results of experimental runs indicating the practicability of such an assembly for routine measurements are reported. (D.C.W.)

14645 (DP-800) A GASEOUS SCINTILLATION COUNTER WITH GAS MULTIPLICATION. Fred H. Giles, Perry Sprawls, Jr., LeConte Cathey (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Nov. 1962. Contract AT(07-2)-1. 24p.

Although signal gains of up to 225 were obtained for gaseous scintillation pulses by application of an electric field as in proportional counter operation, the attainable signal level and corresponding energy resolution were inferior to that achieved by standard crystal scintillators or proportional counters. The method might have some application in analysis of low energy x rays, if the collection and detection of light could be improved. (auth)

14646 (HW-71133) FILM CAPABILITIES FOR HIGH LEVEL DOSE EVALUATION. R. H. Wilson and H. V. Larson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 18, 1961. Contract AT(45-1)-1350. 9p.

An investigation was conducted to determine the high-level dose measuring capabilities of the duPont 558 film packet containing 508-sensitive and 1290-insensitive film emulsions. The accuracy of the film processing system was also evaluated. It was found that for statistically sound high-level dose determinations, the characteristic response curves of 1290 film limits the sensitivity of the beta-gamma film badge dosimeter to an upper limit of about 1500 r. A summary of density and spectrographic measurements on these film emulsions was included. (J.R.D.)

14647 (HW-SA-2849) A LIQUID EFFLUENT MONITOR FOR GAMMA EMITTERS. E. M. Sheen (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 3, 1963. Contract AT(45-1)-1350. 21p.

A sensitive, reliable liquid effluent monitor for gamma-emitting radionuclides was developed for use at the Plutonium Recycle Test Reactor at Hanford. The instrument, which uses an organic scintillator, transistor circuitry, and a four decade logarithmic response count rate meter, was developed to monitor the desired range from about 10^{-5} gamma μc/ml to 10^{-1} gamma μc/ml. The count-rate circuit extends from 10^2 to 10^6 counts/minute and the detector scintillator is a 3-in. dia. by 3-in.-long cylinder of terphenyl-in-polyvinyltoluene. The multiplier phototube anode is capacitively coupled to the pulse amplifying and counting instrumentation and is directly coupled to alarm-trip circuitry. This method provides a sensitive pulse counting system capable of maintaining the alarm at very high count-rates. Two electronic trip circuits are provided which may be set independently to trip at any point on the count rate-meter. All circuitry is solid state for reliable, long-term, low power operation. (auth)

14648 (IKF-6) ABSOLUTEICHUNG VON NEUTRONENDETEKTOREN BEI NEUTRONENENERGIEN VON 13,9 UND 15,6 Mev. (Absolute Calibration of Neutron Detectors for Neutron Energies of 13.9 and 15.6 Mev). O. Meyer (Johann-Wolfgang-Goethe-Universität, Frankfurt am Main, Institut für Kernphysik). Aug. 1962. 14p.

The associated particle method is used to calibrate neutron detectors with neutrons of the $T(d,n)He^4$ reaction. The measured efficiencies of two plastic scintillation counters agree with the calculated values. (auth)

14649 (LNF-62/60) MISURE CON CAMERE DI IONIZZAZIONE IN MATERIALE EQUIVALENTE AL TESSUTO UMANO. (Measuring with Ionization Chamber in Material Equivalent to Human Tissue). Note No. 150. M. Ladu, A. Palma, M. Pelleccioni, and E. Rotondi (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionale, Frascati). July 13, 1962. 9p.

The construction of the tissue-equivalent ionization chamber, composed of C with 10% H_2 and 3.5% N_2, is described. The results of measurements made using the chamber filled with a tissue-sensitive gas are also reported. The sensitivity was determined as a function of the pressure of the filling gas. The change of the saturation current as a function of pressure at various dose intensities is shown graphically. (J.S.R.)

14650 (TID-16186) CIRCUITRY FOR A HIGH ALTITUDE GAMMA SPECTROMETRY SYSTEM. Richard B. Keener (Argonne National Lab., Ill.). May 1962. Contract [W-31-109-eng-38]. 6p. (UAC-6441)

A system for obtaining gamma spectra in the upper atmosphere is described. The circuitry involved in a balloon borne instrument package, including a combination CsI-Pilot B phoswich charged-particle discriminator, and solid state circuits for handling the signals obtained from that detector is described. The instrument observes energies from 0.3 to 3 Mev. The means for transmitting the data back to the surface and the ground equipment used for processing it are also discussed. The final information includes total count accumulated throughout a balloon flight, count rate versus altitude, and spectrum analysis of the energies observed. A tape system was also designed for recording the information in chronological order for later analysis. Means of calibrating the equipment and methods of observing circuit behavior during field operations are also described. (auth)

14651 (TID-18055) THE SIMPLIFIED NEUTRON COUNTER TELESCOPE (thesis). Hyun Chang Kim (Ohio State Univ., Columbus). 1961. Contract [AT(11-1)-605]. 38p.

Details are given concerning fabrication and testing of a neutron counter telescope for use in measuring the absolute differential cross of the $D(d,n)He^3$ reaction at 0° direction at 0.55 to 1.23 Mev, and the cross section for the $N^{14}(d,n)O^{15}$ at 1.187 Mev. Differential cross section data on these re-

actions are tabulated and compared with results obtained by other workers. (J.R.D.)

14652 (UR-619) A DEVICE FOR MEASUREMENT OF THORON IN THE BREATH. John B. Hursh and Arvin Lovaas (Rochester, N. Y. Univ. Atomic Energy Project). Nov. 8, 1962. Contract W-7401-eng-49. 28p.

A device was developed to measure thoron in the breath of human subjects. It depends upon the adsorption of thoron on a cooled, charcoal particle covered plate which is adjacent to a ZnS coated lucite disc seen by a 5-in.-dia. photomultiplier tube. In its present form it will measure thoron referred to the patient's mouth with a sensitivity of 0.7 counts per minute per pico-curie of thoron per minute with a background of less than 0.2 counts per minute. If a 10 l/min ventilation rate is assumed, the system would detect thoron in concentrations of 0.1 pico-curies per liter breath. The minimum level for measurement in 10 min is a breath output of 10 pico-curies per min. It is also shown that, when used to measure Th^{228} in solution, the device has a sensitivity of 1.6 counts per minute per pico-curie of Th^{228}. (auth)

14653 (WCAP-2175) MINIATURE NEUTRON DETECTOR DEVELOPMENT. Quarterly Progress Report for Period, October 1, 1962–December 31, 1962. J. Weisman, ed. (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(30-1)-2827. 11p. (EURAEC-558)

Counting characteristics of the diodes prepared in the last quarter were evaluated at elevated temperatures. Four were useful as α detectors at 200 to 400°C. Several additional diodes were fabricated and property measurements carried out. Final evaluation of counting characteristics remains to be done. The Van de Graaff generator was set up as a proton accelerator. Damage studies were delayed by difficulties with the high temperature furnace. Arrangements were made for a cooperative program with the CEN laboratories at Mol, Belgium. CEN will irradiate several Westinghouse diodes at BR-1 and study radiation damage build-up and annealing. (auth)

14654 INSTALLATION FOR THE CALIBRATION OF RADIATION SOURCES BY THE CAVITY CHAMBER METHOD. J. Cohen and M. Oncescu. Acad. Rep. Populare Romine, Studii Cercetari Fiz., 13: 339-47(1962). (In Rumanian)

Cavity-type ionization chambers were used for calibrating the γ-emission of certain radionuclides. The method which represents a generalization of the free-air chamber, is based on the Brag-Gray relation prevailing between the energy delivered by a beam of x rays or γ rays in a medium and the energy lost by the secondary electrons generated in a gas cavity; it may be used in the energy range from 300 kev to 3 Mev. In order to increase the accuracy of the method, the temperature of the room used for the measurements was kept constant within 0.1°C. An electrometer with a vibratory condenser, serving as a zero indicator, was used for the measurement of the ionization current. The nonlinearity of the system was found to be less than 2.5%. (TTT)

14655 RESEARCH ON LIQUID SCINTILLATORS USED FOR THE MEASUREMENT OF SOFT BETA RAYS. H. Duquesne, J. Govaerts, G. Gueben, and J. V. Putzeys. Ann. Soc. Sci. Bruxelles. Ser. I, 76: 105-12(1962). (In French)

A study was made to outline the various principles which should guide the selection of the scintillating mixture to be used for the measurement of soft beta rays. Only organic compounds are considered. The composition of the liquid scintillator—the solvent, diluent, and intermediary or activating solvent—is first considered. The effect of temperature on the background and on the scintillator–photomultiplier arrangement is next discussed. The effect of distillation and degassing is also briefly reviewed. (J.S.R.)

14656 CRITICAL STUDY OF THE RADIOCARBON DATING METHOD USING LIQUID SCINTILLATORS. M. Cuypers, H. Duquesne, G. Germai, J. Govaerts, G. Gueben, and J. Michiels. Ann. Soc. Sci. Bruxelles. Ser. I, 76: 113-26(1962). (In French)

The studies made in creating a C^{14} dating laboratory operating on a routine basis and using the liquid scintillation method are reported. The selection of a suitable scintillator and its chemical synthesis is described. The procedure used for the synthesis of methyl borate which gives an improved yield is given. The precisions necessary to meet the dating requirements are described as an introduction to a consideration of the two measurement apparatus. One apparatus has two photomultipliers and the other only one. A comparison of the two apparatus show that the 2-PM device is especially suitable for young samples, whereas the 1-PM device can be used for samples aged 3000 to 25000 years. A comparison is made of the causes of the background of the two installations. (J.S.R.)

14657 ON THE MECHANISM OF THE CORONA SPARK COUNTER. H.-J. Belitz (Universität, Gissen, Ger.). Atomkernenergie, 8: 17-25(Jan. 1963). (In German)

An idea of the mechanism of the corona spark counter is developed. It is based on the condition that a stable corona discharge exists, and it takes into consideration the connection between the gas multiplication near the anode and the elementary processes (recombination, storage) in the area away from the anode. Some measurements which are incomprehensible from the viewpoint of the Saha-Nath theory are thereby explained. The Saha-Nath theory is discussed; it is incorrect in some points and contradicts Townsend's theory of the corona mechanism. Townsend's corona theory can be considered as valid even under the special conditions in corona spark counters (very small electrode gap). (auth)

14658 RECOIL RADIATION IN PROPORTIONAL COUNTING TUBES. W. Fett (Freien Universität, Berlin). Atomkernenergie, 8: 25-32(Jan. 1963). (In German)

Recoil atoms of α-decay, which penetrate the counting chamber of an ordinary proportional counter during window- and gridless-measurements, are included in the count and can, at best, cause an effect corresponding to the α-impulse rate in β-measurements of thin layers. The evidence of recoil rays can be brought forth both qualitatively as well as quantitatively. The impulse rate relationships which are of interest for quantitative testing or for the application of a counter are reported on for sample cases of radon- and thoron- follow-up products. The possible interfering influence during β-measurements as well as the useful application of recoil radiation are pointed out. (auth)

14659 PREPARATION OF A SCINTILLATING MIXTURE FOR THE DETERMINATION OF THE TRITIUM ACTIVITY OF TRITIATED BENZENE SYNTHESIZED FROM WATER. J. Leclipteur. Bull. Soc. Roy. Sci. Liege, 31: 672-8(1962). (In French)

With the purpose of measuring the tritium activity in benzene synthesized from tritiated water, scintillating mixtures were prepared which permit counting at temperatures from −10 to −15°C. Measurements made with two different installations indicated the most efficient mixture. It is composed of 11.5 cc benzene, 3.5 cc toluene SG, and

PBD and POPOP at concentrations of 5 g/l and 0.05 g/l, respectively. (tr-auth)

14660 THE USE OF NUCLEAR EMULSIONS TO ESTIMATE STRAY NEUTRON SPECTRA NEAR PARTICLE ACCELERATORS. R. Sanna and K. O. O'Brien (U. S. Atomic Energy Commission, New York). Health Phys., 9: 25-9(Jan. 1963).

The stray neutron field near a particle accelerator generates proton recoil tracks, of various lengths and orientations in photographic emulsions. The lengths are directly convertible to proton kinetic energies by use of five formulas. Three of these are least-square, straight-line fits of the experimental data of Lattes, Fowler, and Cuer, while the other two are the empirical equations of Bradner, Smith, Barkas, and Bishop, and W. H. Barkas. If the proton recoils are counted over all directions, then an analysis will show that the probability that a neutron of energy, E_n, will cause a proton to recoil with an energy, $E < E_n$, is σ/E_n. Therefore, the relative neutron flux density per unit energy interval per hydrogen atom, N(E), is related to the number of recoil protons per gram of absorbing material per unit energy interval, P(E), by: $N(E) = [(-E/\sigma)(dP(E)/dE)]$, where E is the incident neutron energy in Mev and σ is the n-p cross section for hydrogen at energy E. Because the proton track can only be counted if it both begins and ends in the emulsion, it is necessary to correct for the probability, increasing with energy, that a proton track will escape the emulsion. A correction based on the geometry of the emulsion has been derived. Having established the proton distribution by measurement and correction for protons escaping the emulsion, the Gregory-Newton forward difference formula was used to determine (dP/dE). The initial use of this technique was to measure the stray neutron spectrum with Ilford G-5 emulsions, near the Brookhaven National Laboratory Cosmotron. The resulting neutron spectrum is exhibited. (auth)

14661 MONITORING INTERMEDIATE ENERGY NEUTRONS. Dale E. Hankins (Los Alamos Scientific Lab., N. Mex.). Health Phys., 9: 31-9(Jan. 1963). (LADC-5194)

A description is given of intermediate-energy neutron monitoring techniques studied at the Los Alamos Scientific Laboratory. A recently developed instrument for simultaneously monitoring neutrons with energies from thermal to 7 Mev is discussed. Experimental data obtained using several instruments and techniques with various neutron spectra are compared. The relative dose rates of thermal, intermediate, and fast neutrons under various shielding conditions are presented, and the techniques for monitoring intermediate energy neutrons are evaluated. (auth)

14662 A LIQUID SCINTILLATION COUNTER FOR THE ABSOLUTE ACTIVITY DETERMINATION BY THE EXTRAPOLATION METHOD. G. Wangermann (Institut für Angewandte Radioaktivität, Leipzig). Isotopen Tech., 2: 357-9(Dec. 1962). (In German)

A measurement apparatus is described which is suitable for the determination of the absolute β activity of radioisotopes by a method first given by Belcher and which was proved in routine operation over a long time. The technique of preparation and some measurement results are reported. Different problems of the measurement methodics are explained, but a detailed discussion is reserved for a later paper. (tr-auth)

14663 AN IRON-FREE MAGNETIC DOUBLE LENS β SPECTROMETER FOR β-γ COINCIDENCE MEASUREMENTS. L. Funke, J. Schintlmeister, and L. Werner (Zentralinstitut fur Kernphysik, Rossendorf, Ger.). Kernenergie, 5: 734-46(Oct.-Nov. 1962). (In German)

A magnetic double lens spectrometer with compensation for the earth's field was described. At a transmission of about 0.2%, it has a resolution of 1.3% and at a transmission of 3%, a resolution of 3%. Electron energies up to 5 Mev can be measured with an accuracy of 10^{-3}. The values determined for Cs^{137} for the most favorable ratio of transmission to resolution were given in dependence on the coil, diaphragm, and source geometry. The extension of the apparatus to a β-γ coincidence spectrometer using scintillation detectors and a fast-slow coincidence device of 16-nsec resolution time was described. The control measurements carried out on Hf^{181} and Hg^{203} were reported. (tr-auth)

14664 A PULSE DENSITY METER WITH LOGARITHMIC RISE. E. Johannes (Technische Universität, Dresden). Kernenergie, 5: 747-52(Oct.-Nov. 1962). (In German)

A device that makes possible the determination of pulse densities over a range of more than 6 decades without switching is described. A pentode circuit in which the control grid acts as a logarithmic term is the basis of the apparatus. The sensitivity obtainable in comparison with that of linear pulse density meters is discussed. An operational example is given. (tr-auth)

14665 CHARGE AMPLIFICATION, NOISE, AND CONSTANCY OF CHARGE-SENSITIVE FEEDBACK PREAMPLIFIERS. J. Dubrau (Technische Universität, Dresden). Kernenergie, 5: 752-65(Oct.-Nov. 1962). (In German)

A general investigation of linear amplifiers with charge amplification defined as the characteristic parameter was made. The charge amplification was calculated for all general imput circuits. The important sources of noise were combined in an equivalent noise level, and the sensitivity-determining parameters were calculated. It was shown that feedback affects the sensitivity through the circuit elements necessary for its realization. A comparison of the charge feedback amplifiers with voltage feedback amplifiers shows that the selection of the circuit depends on the constancy of the detector capacity. If the constancy of this capacity is less than the measurement accuracy desired, charge feedback is advantageous, whereas in all other cases voltage feedback is superior. (tr-auth)

14666 PROPERTIES OF SOME COLLIMATORS FOR INTRODUCTION INTO SCINTISCANNER. II. MEDICAL APPLICATIONS. G. Nentwig, E. Dressler, and H.-J. Correns (VEB Vakutronik, Dresden and Friedrich-Schiller-Universität, Jena, Ger.). Kernenergie, 5: 766-74(Oct.-Nov. 1962). (In German)

At the conclusion of Part I, special applications to medical areas of the collimators described were proved, and their applicability was verified by statistical considerations. Three conus collimators with different slits are well suited for the detection and determination of the site of areas of slightly increased radioactivity in the human body such as can occur as metastases of a thyroid carcinoma. The conus collimators permit the boundaries of large organs, as the liver, to be defined and the activity distribution within the organ to be summarized. The scintigraphic representation with high resolution of organ contours and areas of different activity in small organs, such as the thyroid which concentrates radioactive iodine very strongly in comparison with the underlying tissue, makes possible a 9- or 19-channel collimator. With waiver of optimum resolution for higher effectivity, it is possible with the collimator with the smallest slit to represent with sufficient legibility

of the scintigram tumorous regions in a thyroid lobe after application of only 3 μc I^{131}. (tr-auth)

14667 ON THE ABSOLUTE DETECTION EFFICIENCY OF A CYLINDRICAL SCINTILLATION PHOSPHOR IN THE CASE OF AN EXTENDED PLANE γ-RAY SOURCE. C. C. Grosjean (Univ. of Ghent, Belg.). Nucl. Instr. Methods, 17: 289-309(Dec. 1962). (In English)

Practical formulae are established, permitting an accurate evaluation of the absolute detection efficiency T(E) of a cylindrical scintillation phosphor for extended plane γ sources. The special case of a circular disk source of radius R appears to be of particular interest. The efficiency for such a source, represented by a complicated triple integral, is developed as a power series of R by means of an elementary transformation method. This method entails such extensive calculations that it is only used to obtain a preliminary formula exact up to the R^2 term. However, a more advanced study of certain peculiar characteristics of the integral representation of the disk source efficiency leads to another method offering the possibility of an extension of the mentioned formula to all powers of R with a minimum of intermediate steps. As it appears to be sufficient for practical purposes, this method is applied to establish a fourth order formula for the circular disk source. The formalism is generalized to the case of an arbitrarily shaped plane source, and the final result is a formula expressing T(E) as a simple polynomial in terms of a point source efficiency and its first four partial derivatives, with respect to the crystal radius r. A discussion is given of the numerical aspects of the problem under study. A set of formulae permitting an easy evaluation of point source efficiencies within a high degree of precision is presented. Among them, there is a numerical integration procedure applicable to cases where the variation of the integrand is approximately exponential. It is shown how the required partial derivatives can be simply obtained by means of a finite difference method. In this way, it appears that the computation of five properly chosen point source efficiencies suffices to evaluate the detection efficiencies for an infinite variety of extended sources. This conclusion is illustrated by means of a typical numerical example. (auth)

14668 A TRANSISTORIZED FAST COINCIDENCE CIRCUIT FOR USE WITH SLOW SCINTILLATORS. S. Rozen and M. Etzion (Atomic Energy Commission, Tel-Aviv, Israel). Nucl. Instr. Methods, 17: 332-6(Dec. 1962). (In English)

A fast coincidence circuit for current-pulse input consisting of two limiters, a sensitive voltage discriminator and an output stage is described. The application of the clipped pulses to the discriminator and the d-c coupling throughout the circuit permit operation at high coincidence rates. A resolving time of 7 nsec at 100% coincidence efficiency is realized with 3" NaI (Tl) scintillators, 58 AVP photomultipliers and a 2 × 2.5 nsec clipping line. Simple circuitry and high discrimination threshold stability result in very reliable operation. (auth)

14669 A SURVEY OF THE LATEST DEVELOPMENTS IN DELAYED COINCIDENCE MEASUREMENTS. Arthur Schwarzschild (Brookhaven National Lab., Upton, N. Y.). Nucl. Instr. Methods, 21: 1-16(Jan. 1963). (BNL-6290). (In English)

A survey of the techniques for measurement of submillimicrosecond nuclear lifetimes by the delayed coincidence method is presented. The time response and limitations of photomultiplier, plastic scintillator, and associated electronics are discussed. Illustrative examples of the use of the method are presented. (auth)

14670 A MULTIPLE PULSE DISPLAY SYSTEM. L. Cucančić (CERN, Geneva). Nucl. Instr. Methods, 21: 53-5(Jan. 1963). (In English)

A method for simultaneous pulse height analysis of many coincident pulses is described. The pulses obtained from several scintillation and Čerenkov counters are shaped in fast linear gates, and fed as current pulses into a delay line at different points. The train of pulses in the delay line is fed to an oscilloscope and photographed. It is possible to display simultaneously up to 20 pulses. (auth)

14671 COUNTING RATE VARIATIONS OF GAIN AND RESOLUTION IN PHOTOMULTIPLIERS OF THE RCA 6810A TYPE. W. Michaelis, H. Schmidt, and C. Weitkamp (Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Instr. Methods, 21: 65-74(Jan. 1963). (In German)

The variations in gain and resolution of RCA 6810A photomultiplier tubes were investigated with reference to changes in the illumination of the photocathode. The tubes were mounted to a NaI(Tl) crystal and irradiated with γ rays of different energies and intensities. Changes in the counting rate result in reversible fast and slow variations in gain. An increase of the irradiation level causes a rapid positive initial change with a continuing slow rise followed by a gradual decline to a stable level. Magnitude and exact time dependence vary with multiplier load and past history. Moreover, the amplitude is different for every tube. A reduction of counting rate results in a sudden negative initial shift with a continuing slow decrease. The long-term instabilities are discussed in detail. They may be attributed to reversible changes in the secondary emission ratio of the dynode surfaces. The resolution was found to deteriorate with increasing irradiation intensity. (auth)

14672 THE MEASUREMENT OF RADIOACTIVE CONTAMINATION ON HANDS AND FEET. A. R. Jones (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nucl. Instr. Methods, 21: 75-80(Jan. 1963). (In English)

There is a need for simple instruments capable of rapid monitoring of beta contamination on hands and feet. For this reason hand and foot monitors were designed using large areas of thin plastic scintillators. Except in the case of contamination near the tolerance level a decision is rapidly made. The same kind of decision circuit was also used in a hand alpha monitor employing a zinc sulfide scintillator. (auth)

14673 PHOTOGRAPHY OF ČERENKOV RINGS PRODUCED BY SINGLE PARTICLES IN A GAS. D. M. Binnie, M. R. Jane, J. A. Newth, D. C. Potter, and J. Walters (Imperial Coll., London). Nucl. Instr. Methods, 21: 81-4 (Jan. 1963). (In English)

Čerenkov light from fast particles is emitted in a cone, and consequently may be focused by a lens or mirror to give an image in the form of a ring. A report is given on the photography of such rings using an image intensifier system. The Čerenkov light was produced by 700 Mev/c mesons traversing a gas. (auth)

14674 A SIMPLE TRANSISTORIZED FAST COINCIDENCE CIRCUIT WITH A WIDE ENERGY RANGE. (FROM 30 kev). M. Sidi and U. Sold (Israel Atomic Energy Commission Labs., Rehovoth). Nucl. Instr. Methods, 21: 89-92(Jan. 1963). (In English)

A fast coincidence circuit is described. The circuit is suitable for fast coincidences of pulses of different ampli-

tudes. Pulses originating from two photomultipliers were used, with 30 kev and 500 kev γ rays respectively. Two fast mesa transistors form, with a single delay line, the shaper and coincidence stage. A tunnel-diode serves as a discriminator and output stage. Simplicity and short resolving time (8.5 nsec) are the main features of the circuit. (auth)

14675 PULSE-SHAPE DISCRIMINATION WITH A GLASS SCINTILLATOR. C. Coceva (CNEN, Ispra, Italy). Nucl. Instr. Methods, 21: 93-6(Jan. 1963). (In English)

It is found that a lithium-loaded glass scintillator gives light pulses with different shapes if excited by the $Li^6(n,\alpha)H^3$ reaction products or by Compton electrons. This difference can be used, by means of the pulse-shape discrimination technique, to decrease the γ ray detection efficiency with respect to the slow-neutron efficiency. (auth)

14676 THE PREPARATION OF LITHIUM-DRIFTED SEMICONDUCTOR NUCLEAR PARTICLE DETECTORS. C. A. J. Ammerlaan and K. Mulder (Inst. for Nuclear Physics Research, Amsterdam). Nucl. Instr. Methods, 21: 97-100(Jan. 1963). (In English)

A method is described for the preparation of p-i-n structure semiconductor nuclear particle detectors using the process of ion drift. The procedure is described in detail and much attention is given to the measurements of parameters which control various steps in the procedure. The reproducibility, obtained by the method, turned out to be very high. The properties of the detectors are described briefly. (auth)

14677 A SYNCHRONISING DISCRIMINATOR FOR SCINTILLATION COUNTER PULSES. P. R. Orman (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucl. Instr. Methods, 21: 121-5(Jan. 1963). (In English)

An amplitude discriminator circuit is described which is suitable for use with pulses from fast scintillation counters. One part of the circuit provides an output pulse which is closely synchronized to the input pulse over a wide range of amplitude. The output of this circuit is gated by that of a conventional tunnel diode discriminator. The combination forms a synchronizing discriminator whose output pulse has been shown to shift by less than 1 nanosecond when the input pulse amplitude is varied from 8 to 60 ma. (auth)

14678 SPARK CHAMBERS WITH FERRITE CORE MEMORIES. John R. Waters (Princeton Univ., N. J.). Nucl. Instr. Methods, 21: 126-8(Jan. 1963). (PPAD-461-E). (In English)

It is demonstrated that small, conventional ferrite memory cores can be used with a wire spark chamber for recording spark locations. This removes the necessity for photographing the spark tracks and enables the information to be fed directly into a computer for analysis. (auth)

14679 A METHOD TO MEASURE PHOTONEUTRON MULTIPLICITY. S. Costa (Università, Turin and Istituto Nazionale di Fisica Nucleare, Turin). Nucl. Instr. Methods, 21: 129-35(Jan. 1963). (In English)

A statistical method is described to measure the multiplicity of photo-neutrons produced with pulsed machines. (auth)

14680 A TOTAL ABSORPTION SCINTILLATION DETECTOR FOR ELECTRONS, PHOTONS AND OTHER PARTICLES IN THE Gev REGION. G. Backenstoss, B. D. Hyams, G. Knop, and U. Stierlin (CERN, Geneva). Nucl. Instr. Methods, 21: 155-60(Jan. 1963). (In English)

A report is presented on measurements taken with a total absorption scintillation detector. The energy response and the resolution of the counter was investigated with electrons between 1 and 10 Bev/c. It appears that the counter provides a practical linear device for the measurement of electron or γ-ray energies in this region. The counter is shown to be able to discriminate between electrons, μ mesons, and nuclear interacting particles in a beam of defined momentum. (auth)

14681 MOMENTUM MEASUREMENTS OF HIGH-ENERGY PARTICLES IN EMULSION IN A STRONG PULSED MAGNETIC FIELD. E. Marquit and E. Skrzypczak (Univ. of Warsaw). Nucl. Instr. Methods, 21: 174-6 (Jan. 1963). (In English)

An improvement in the accuracy of the momentum measurements can be obtained if the emulsion stack is exposed perpendicularly, rather than parallel, to the beam. In this way, the error due to multiple Coulomb scattering is reduced. An experimental arrangement of the emulsion pellicles is described, and the amount of error for 24-Bev/c particles is calculated. (D.L.C.)

14682 ON THE INDUCED CHARGE IN SEMICONDUCTOR DETECTORS. G. Cavalleri, G. Fabri, E. Gatti, and V. Svelto (CISE, Milan). Nucl. Instr. Methods, 21: 177-8(Jan. 1963). (In English)

The induced charge in an ionization chamber is usually represented by $\Delta q = e\Delta x/d$ (1) or $\Delta q = e\Delta V/V$ (2), where V = voltage across the device, d = spacing between electrodes, and ΔV = potential difference between two points spaced Δx along the path of the charge e. Equation (1) is shown to be valid in the presence of a fixed space charge (depletion layer), while equation (2) is not. (D.L.C.)

14683 MESON STOP DETECTOR. A. F. Dunaitzev, V. I. Petrukhin, Yu. D. Prokoshkin, and V. I. Rykalin (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Instr. Methods, 21: 179-80(Jan. 1963). (In English)

A scintillation stop detector is described which has high selective sensitivity (ratio of recording efficiency for stopping particles to that of passing ones, $K \sim 50$). The response of the detector was investigated with 75-Mev π^+ mesons. The dependence of the meson counting rates on the pulse delay and moderator thickness is discussed. (D.L.C.)

14684 MEASURING FAST-NEUTRON FLUXES IN MIXED NEUTRON-GAMMA FIELDS. Stanley Kronenberg (Army Signal Research and Development Lab., Fort Monmouth, N. J.). Nucleonics, 21: No. 3, 78; 80; 82(Mar. 1963).

A fast-neutron monitoring device that is insensitive to gamma rays and a gamma system that ignores neutrons provide separate monitoring of mixed gamma-neutron fields. Design and operation are described. (D.C.W.)

14685 THE BP-3 HEAVY LIQUID CHAMBER: GENERALITIES. A. Lagarrigue (Ecole Polytechnique, Paris). Onde Elec., 41: 976-82(Dec. 1961). (In French)

The characteristics of the various types of radiation detection instruments are briefly summarized to indicate the specific use of each. The development of the bubble chamber is reviewed. Then the physics of the heavy liquid chambers are discussed and some examples of its use are given. The factors considered in the selection of the chamber parameters are reviewed, and the construction problems are considered. (J.S.R.)

14686 THE BP-3 HEAVY LIQUID CHAMBER: DESCRIPTION OF THE CHAMBER. A. Rousset (Ecole Polytechnique, Paris). Onde Elec., 41: 983-8(Dec. 1961). (In French)

The general principles in the construction of the BP-3 heavy liquid chamber are given with a consideration of the technical difficulties involved and the advantages of such a chamber. The electro-magnet, the body of the chamber itself, the safety enclosure and the cameras, the expansion system, temperature control, and handling and operation of the chamber are described in some detail. (J.S.R.)

14687 THE BP-3 HEAVY LIQUID CHAMBER: ELECTRONIC EQUIPMENT. P. Rançon (Ecole Polytechnique, Paris). Onde Elec., 41: 989-93(Dec. 1961). (In French)

The operation of a bubble chamber comprises the operations of expansion, illumination, and recompression—the basic operation of the chamber. The electronic devices controlling these operations are described. Auxiliary devices operating the camera and counting the number of events are then briefly considered. (J.S.R.)

14688 THE LIQUID HYDROGEN BUBBLE CHAMBER CBH-81: GENERALITIES. R. Florent (Centre d'Etudes Nucléaires, Saclay, France), B. Gregory, and R. Maillet. Onde Elec., 41: 1001-6(Dec. 1961). (In French)

The conception of the CBH-81 and its realization are briefly considered, and the principles of a hydrogen bubble chamber are summarized. Then a general description of the CBH-81 with its installation at CERN is given. (J.S.R.)

14689 THE LIQUID HYDROGEN BUBBLE CHAMBER CBH-81: THE CHAMBER AND ITS EXPANSION. A. Garçon (Centre d'Etudes Nucléaires, Saclay, France). Onde Elec., 41: 1007-15(Dec. 1961). (In French)

The design of the chamber itself is described using a schematic cross section. The construction with the problems involved in the selection of material, selection of type of fabrication and machining, and engineering is discussed. The expansion operation and the control of the drive fluid are described. (J.S.R.)

14690 THE LIQUID HYDROGEN BUBBLE CHAMBER CBH-81: THERMAL CONTROL. A. Garçon and R. Blondet (Centre d'Etudes Nucléaires, Saclay, France). Onde Elec., 41: 1016-19(Dec. 1961). (In French)

The temperature in the hydrogen bubble chamber must be controlled within 0.1° between 24 and 28°K, and the temperature chosen must be maintained constant and homogeneous within ±0.05°. The thermal insulation used to help maintain those temperatures is illustrated. The design of the pressure control and its characteristics are discussed. In conclusion, the problems posed by the liquid nitrogen and liquid hydrogen circuits are considered. (J.S.R.)

14691 THE LIQUID HYDROGEN BUBBLE CHAMBER CBH-81: THE ELECTROMAGNET AND ELECTRONIC CIRCUITS. C. Allard and R. Florent (Centre d'Etudes Nucléaires, Saclay, France). Onde Elec., 41: 1020-4(Dec. 1961). (In French)

The design and operation of the electromagnet coils are described. The electronic circuits used so that expansion and photography occur at the precise moment of the particle passage are discussed. The circuits considered include electronic phasing, flash feed, measurement and control, and operational fault detectors. (J.S.R.)

14692 THE LIQUID HYDROGEN BUBBLE CHAMBER CBH-81: THE OPTICS. J. Badier (Ecole Polytechnique, Paris). Onde Elec., 41: 1025-8(Dec. 1961). (In French)

The optical system of a bubble chamber in coordination with the chamber assembly is complex. Some indication of the problems and the solutions derived is given by a discussion of the illumination of a bubble by a beam of parallel light, chamber illumination, position of the objective, selection of the objective and film, optical quality of various portholes, obtaining a black background, antireflection treatment of surfaces, and cameras and flashes. (J.S.R.)

14693 THE LIQUID HYDROGEN BUBBLE CHAMBER CBH-81: PROTECTION AND SAFETY. F. Pénet (Centre d'Etudes Nucléaires, Saclay, France). Onde Elec., 41: 1029-33(Dec. 1961). (In French)

In the operation of a liquid hydrogen bubble chamber, danger to personnel and to the apparatus from the utilization of gas liquified at low temperature and from the utilization of hydrogen at the same time as explosive gas must be guarded against. The precautions and monitoring in the area of chamber protection, vacuum surveillance, and prevention of explosive mixtures are described. (J.S.R.)

14694 THE ANALYSIS OF BUBBLE CHAMBER PHOTOGRAPHS. J. Crussard (Centre d'Etudes Nucléaires, Saclay, France). Onde Elec., 41: 1042-6(Dec. 1961). (In French)

After the bubble chamber photographs are obtained it is necessary to find the events, measure them, and make the necessary calculations. For scanning the photographs nothing has yet replaced the human eye. But in the measurement and calculation, the trend has been to automation. The principle of measurement apparatus and programming for the calculations is briefly summarized. The most recent developments in the measurement automation are indicated. (J.S.R.)

14695 A PULSE TAPE-RECORDER FOR CLINICAL RADIOISOTOPE WORK. R. J. T. Herbert and D. B. Hyde (Liverpool Radium Inst.). Phys. Med. Biol., 7: 455-62 (Feb. 1963).

The design and construction of a special recorder using a domestic tape-deck for making a permanent record of the pulses from a scintillation counter on tape are described. By using transistor flip-flop circuits a defined paralysis time, longer than the revolving time of the tape, is introduced before recording. This ensures exact reproduction of recorded counts. Applications of the recorder are discussed briefly. (P.C.H.)

14696 THE MECHANISM OF THE INTRODUCTION OF A RADIOACTIVE ISOTOPE INTO A NUCLEAR EMULSION. K. B. Zaborenko, V. I. Korobkov, and K. A. Radovich. Radiokhimiya, 4: 715-20(1962). (In Russian)

Nuclear emulsions were considered to represent the most sensitive method for the qualitative and quantitative recording of α-radiation; it was therefore attempted to clarify the mechanism of the absorption of the radioactive isotopes by the emulsion during the impregnation process, in order to increase the precision and the reliability of the measurements. Beta-active isotopes, such as Th^{234}, Sr^{89}, and Ce^{141}, were used for the study which included the determination of the pH, the concentration foreign atoms, and other parameters. The activity after impregnation and drying was determined by means of a β-counter, keeping the relative error of the measurements below 3%. The 50-micron thick nuclear emulsion contained up to 85% AgBr and about 15% gelatin. The results indicated that impregnation of the emulsion with the radioactive isotope takes place by means of an ion exchange between the solution and the gelatin. Distribution of the isotope between the

emulsion and the solution after an equilibrium is established is controlled by the distribution coefficient of the isotope in question; the process itself is determined by the exchange constant. If an equilibrium is not reached, the distribution depends on the impregnation coefficient which must be determined individually for each isotope–emulsion system under the experimental conditions used. (TTT)

14697 LIGHT PIPE FOR A LARGE-AREA SCINTILLATOR. Paul Gorenstein and David Luckey (Massachusetts Inst. of Tech., Cambridge). Rev. Sci. Instr., 34: 196-7(Feb. 1963). (TID-17249)

A light pipe using gross fiber optics was constructed for optically coupling an 18 × 16 × 0.25 in. plastic scintillator to a 2-in. dia. photomultiplier. The pipe consists of eight separate 18 × 2 × 0.25 in. Plexiglas strips which match to the 16 × 0.25 in. edge of the scintillator. The strips are twisted in going from the scintillator to the photomultiplier and resemble a fan. The performance of the light pipe was found superior to two other light pipes of conventional construction; the efficiency of light collection was ~25%. The behavior of a scintillation counter equipped with the light pipe was studied. (D.L.C.)

14698 THE RESOLVING POWER OF SCALERS WITH A FAST PRESCALER. M. Van Tol (Philips Gloeilampenfabrieken, Eindhoven, Netherlands). Sci. Ind., 8: No. 6, 16-20(1961).

Discussion is given on the counting of pulses with a random distribution in time, of which, averaged over a sufficiently long period of time the number is constant. The problem occurs in the measuring of nuclear radiation. The resolving power of the scalers used for this purpose was studied, and the derivation of the formulas employed is appended. The possibility of increasing the resolving power more than proportionally by means of a very fast prescaler is shown. (P.C.H.)

14699 THE ANALYSIS OF A GAMMA SCINTILLATION SPECTROMETER. H. P. Nijman and J. L. De Vries (Philips Gloeilampenfabrieken, Eindhoven, Netherlands). Sci. Ind., 8: No. 6, 20-4(1961).

Various units from which a γ spectrometer is constructed, and the requirements that the apparatus has to meet are described. A survey is given of physical principles and phenomena, the knowledge being valuable for the evaluation of γ spectra. (OID)

14700 GAMMA-SPECTROMETRY WITH CONSTANT RELATIVE CHANNEL-WIDTH. A. J. Duivenstijn and L. A. J. Venverloo (Philips Gloeilampenfabrieken, Eindhoven, Netherlands). Sci. Ind., 8: No. 6, 25-8(1961).

A new scanning technique was developed for measurements that require scanning of spectra with constant relative channel width. Pulse-height analysis is obtained by gain scanning. The amplification of the photomultiplier in the scintillation detector is gradually varied, adjustments of both channel height and channel width being kept unchanged. Advantages of gain scanning for specific applications are shown. Spectra obtained with a sliding-channel spectrometer and with a gain-scanning instrument are compared. (P.C.H.)

14701 MEASUREMENT OF VERY LOW BETA-RADIATION LEVELS. A. J. Duivenstijn (Philips Gloeilampenfabrieken, Eindhoven, Netherlands). Sci. Ind., 8: No. 6, 34-8(1961).

The development both of a novel type G-M guard tube, with hollow anode and a high efficiency for cosmic rays, and a matching detector tube for constructing a compact and light detector assembly is described. The accessory electronic instrumentation, operating in anticoincidence, is of conventional design. The performance of the apparatus is clearly indicated by the background count obtained being approximately 1 count/min, taking into account the relatively short measuring times that are required. (P.C.H.)

14702 A VERSATILE AND ADAPTABLE SYSTEM OF NUCLEONIC INSTRUMENTATION. L. A. J. Venverloo (Philips Gloeilampenfabrieken, Eindhoven, Netherlands). Sci. Ind., 8: No. 6, 38-42(1961).

An electronic system covering the whole field of nucleonic measurements is described. It is shown how with a limited number of functional units a wide diversity of instrumentation systems are assembled. Examples are given of a preset count scaler, a linear count-rate meter, and single-channel gamma spectrometers. (OID)

14703 ELECTRONIC ELECTROMETER PARTICULARLY SUITABLE FOR MEASURING THE AMOUNT OF γ-RADIATION. Mieczysław Wiraszko and Aleksander Korol. Tech. Lotnicza, No. 9, 278-9(1962).

A description is given of an electronic electrometer, which employs a vibrating dynamic condenser excited by the generator. The ionization chamber is in the form of a cylindrical capacitor suitable for measuring γ radiation in the range of 0 to 0.150 milliroentgens. It is charged to a definite potential by the electrometer's own voltage stabilizer. It is then subjected to γ radiation thus undergoing the discharge that is proportional to the product of the radiation intensity and time. By placing it in a socket of the dynamic condenser, the displacements of electrostatic charges are detected which, after suitable amplification, are measured by observing the meter readings. (P.C.H.)

14704 THE SCINTILLATION TECHNIQUE IN RADIOMETRY. V. O. Vyazemskii. Moscow, Gosatomizdat, 1961. 432p. (In Russian)

Fundamentals of the scintillation technique for the recording and spectrometry of nuclear radiations are presented. The properties of inorganic, organic, liquid organic, plastic, gas, and glass scintillators in current use are described, and the scintillation process is discussed. The advanced types of photomultiplier tubes, having characteristics of the greatest value from the viewpoint of scintillation techniques, are discussed. The principles of electronic equipment design pertaining to apparatus used in scintillation applications are presented, and several problems in γ-ray scintillation spectrometry and the scintillation spectrometry of charged particles are explained. Examples of practical applications of the scintillation technique in industry and in nonnuclear research are also given. (OID)

14705 ORGANIC SCINTILLATION DETECTORS. COUNTING OF LOW-ENERGY BETA EMITTERS. Eric Schram. Elsevier Monographs. Physics Section. New York, Elsevier Publishing Co., 1963. 222p. $7.50.

A book is presented on counting of low-energy beta emitters by means of organic scintillators. It deals mainly with the mechanisms of luminescence, properties of organic scintillators, practical aspects of scintillation counting, and equipment for scintillation counting. (D.L.C.)

ISOTOPE SEPARATION

14706 (CEA-2214) ETUDE PHYSICO-CHIMIQUE DE LA SEPARATION DES ISOTOPES DU CALCIUM PAR ECHANGE CHIMIQUE ENTRE AMALGAME ET SOLUTION SALINE. (Physico-Chemical Study of the Separation of Calcium Isotopes by Chemical Exchange Between Amalgam and Salt Solutions). P. Duie and G. Dirian (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1962. 20p.

In a preliminary study of the isotopic exchange between Ca amalgam and aqueous or organic solutions of Ca salts, the main parameters governing the feasibility of a separation process based on these systems such as separation factor, exchange kinetics, rate of decomposition of the amalgam were investigated. The separation factor between Ca^{40} and Ca^{46} was found to be of the order of 1.02. The rate of the exchange reaction is rather low for aqueous solutions, extremely low for organic solutions. The amalgam seems not to be attacked by dimethyl-formamide solutions; but it is rapidly decomposed by aqueous solutions of Ca halides. This decomposition is slow in the case of aqueous solutions of calcium formate and still slower for $Ca(OH)_2$; however, except in particular conditions, the observed rate is often much higher, owing to interfering reactions between amalgam and water vapor contained in H_2 bubles. (auth)

14707 (CEA-tr-A-1164) PROCÉDÉ DE PRODUCTION D'EAU LOURDE PAR ÉCHANGE CHAUD ET FROID ENTRE HYDROGÈNE ET EAU. (Process for the Production of Heavy Water by Hot and Cold Exchange between Hydrogen and Water). W. Vielstich, G. Gruneberg, E. Justi, and H. Spengler. Translated into French from German Patent 1,066,555. Oct. 20, 1956. 11p.

A procedure for the preparation of heavy water by catalytic exchange of deuterium between hydrogen and water in a dual-temperature system operating in counter-current is described. The deuterium exchange is made in the presence of pH buffers and by contact with alkaline lye or high porosity catalysts, constituted of simple or double structure Raney grains. The operation is made with a fixed arrangement of tailing catalysts. The cold columns operate at temperatures between 20 and 100°C, and the hot columns between 100 and 250°C. The pressure of the columns is between 1 and 150 kg/cm^2. The concentration of lye taking part in the reaction is kept between $\underline{N}/1000$ and $2\underline{N}$. (tr-auth)

14708 (CEA-tr-A-1229) ENRICHISSEMENT DES ISOTOPES DU CÉSIUM PAR IONOPHORESE SUR COLONNES ÉCHANGEUSES. (Enrichment of Cesium Isotopes by Ionophoresis on Exchange Columns). E. Blasius and N. Neumann. Translated into French from Z. Elektrochem., 65: 475-9(1961). 16p.

Ionophoresis in a cation exchanger was studied using the cesium isotope couple Cs^{134}/Cs^{137}. Elution chromatography showed that the force of the bonding with the exchanger was almost the same for the two isotopes. The difference in mobility of the isotopes in ionophoresis, which leads to a difference of 25% between initial and final fractions, was evaluated to 0.11% and is then of the same order of magnitude as for ionophoresis in fused salts. (tr-auth)

14709 THE OPTIMAL SEPARATION CONDITIONS IN A TRANSDIFFUSION COLUMN WITH HOT WIRE. APPLICATION TO THE NITROGEN ISOTOPES. Gh. Vasaru. Rev. Chim. (Bucharest), 13: 592-6(Oct. 1962).

Optimal conditions for a column designed for the enrichment of the molecular species N^{14} and N^{15} at T_1 = 973°K and T_2 = 285°K were calculated. The results are presented graphically. It is then shown how the obtained parameters can be used to calculate the separation factors and the column length needed to obtain a particular separation. (P.C.H.)

MATHEMATICS AND COMPUTERS

14710 (BNL-6729) MATHEMATICS OF INTERMITTENT IRRADIATION. F. B. Hill (Brookhaven National Lab., Upton, N. Y.). Oct. 1962. Contract [AT(30-2)-Gen-16]. 37p.

Initiation of reactions by intermittent irradiation is frequently encountered in physical, chemical, and biological systems. Mathematical expressions for transient and steady state concentrations of reactive species in these systems are useful for predicting performance and for research purposes. A general method of formulation of the intermittent irradiation problem is presented herein, and illustrative solutions are obtained for radioactive decay chains and for the rotating sector method. 20 references. (auth)

14711 (AERE-R-4250) THE PRESENTATION OF EXPERIMENTAL DATA TO COMPUTER. B. E. Cooper and C. M. Whiteside (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). 1963. 58p.

The problems of data input to a computer is discussed in detail. The use of words in the presentation has numerous advantages in labeling the data and specifying the problem, and permits a record of the data and the problem that is understandable out of its computational context. Methods for data error detection are also described. A package of subroutines written for use with FORTRAN programs, which would enable a program to interpret such a data presentation as mentioned above to be written easily, is described. (H.G.G.)

14712 (CREL-1009(Pt.2)) A DATA PLOTTING SYSTEM FOR USE WITH PUNCHED PAPER TAPE. PART 2. DETAILED DESCRIPTION. J. A. Ladd (Atomic Energy of Canada Ltd., Chalk River, Ont.). Sept. 1962. 76p. (AECL-1655)

A detailed description of the functioning of the various circuit elements in the data plotting system for use with punched paper tape is presented. Complete schematic and block diagrams are included. (H.G.G.)

14713 (IA-777) REDUCTION OF A TRIPLE PRODUCT OF OCTETS. Y. Dothan and H. Harari (Israel. Atomic Energy Commission, Rehovoth). Aug. 1962. 57p.

Some properties of SU_3 are discussed with special attention to its octet representation. The reduction coefficients were calculated for the direct product of three 8-dimensional representations of SU_3. (auth)

14714 (LADC-5639) USE OF THE DISK FILE ON STRETCH. B. G. Carlson and E. A. Voorhees (Los Alamos Scientific Lab., N. Mex.). Feb. 1, 1963. Contract [W-7405-eng-36]. 11p.

High reliability of the disk system in computer programming has been achieved. Its high speed and large capacity permits the use of new data methods. Most uses involve the disk as an extension of the core storage rather than as input-output equipment, and becomes an economical and practical means of extending the effective amount of core storage. Additional speed can be achieved through the use of additional arms to permit simultaneous reading and writing on one disk unit. The recording of observations directly on the disk prior to calculation, thereby bypassing intermediate recording and associated delays, would afford a definite speed advantage. The major advantage of the disk system is its provision for high-speed, large-capacity storage media, a necessity for future large-scale computing systems. (H.G.G.)

14715 (NAA-SR-Memo-7824) KUMQUAT—A COMPUTER PROGRAM FOR KINETIC PARAMETER EVALUATION FROM INVERSE PERIOD DATA. W. A. Rhoades (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Oct. 18, 1962. Contract [AT(11-1)-Gen-8]. 20p.

The non-linear variation of inverse period with reactivity above prompt critical can be analyzed in terms of a hypothetical additional group of delayed neutrons. A computer program, called KUMQUAT, is shown which performs this analysis automatically. Instructions for use of the program, a listing of the FORTRAN source deck, and a sample problem are included. (auth)

14716 (NLCO-868) A TRAVELOG OF ANALOGS. J. A. Williamson (National Lead Co. of Ohio, Cincinnati). Feb. 8, 1963. Contract AT(30-1)-1156. 26p.

The basic analog computer circuits used to perform various mathematical operations and the functions performed by nonlinear equipment are described. The type and size of equipment applied to three different types of problems are presented. (auth)

14717 (TID-17950) TECHNICAL PROGRESS REPORT. PART I. HIGH-SPEED COMPUTER PROGRAM. PART II. CIRCUIT RESEARCH PROGRAM. PART III. SWITCHING THEORY. PART IV. MATHEMATICAL METHODS. PART V. ILLIAC USE AND OPERATION. PART VI. IBM 7090-1401 SYSTEM. PART VII. INSTRUCTIONAL USE OF THE IBM 7090-1401 SYSTEM. PART VIII. GENERAL LABORATORY INFORMATION. (Illinois. Univ., Urbana. Digital Computer Lab.). Dec. 1962. Contract AT(11-1)-415. 57p.

Work in the high-speed computer program is reported on component testing, maintenance, delayed control sequence modification, core memory operation, and diagnostic programming. Circuit research included investigation of flip-flop switching theory, development of hybrid counter circuits using tunnel diodes and emitter followers, and circuit revisions in the statistical analyzer. In switching theory investigations, calculation of the maximum number of the most efficient error-detecting and correcting codes was attempted by use of Boolean algebra. Mathematical formulations of these combinations are given. Data on the distribution of Illiac machine time are presented tabularly. Two new routines were added to the IBM 7090 library during the report period. A review of IBM 7090 problem specifications for the period is presented. (J.R.D.)

14718 (TID-18030) A DISC-ORIENTED REMOTE INQUIRY PHILCO 2000 SYSTEM. E. D. Reilly, Jr. (Knolls Atomic Power Lab., Schenectady, N. Y.). [1962]. Contract [W-31-109-eng-52]. 6p.

A system for remote station access to a large-scale digital computer is described which offers advantages for the running of debugging procedures, sequential design problems, form sheet calculations, and problems that reference library data. A specific method was outlined for implementing such a system through the combination of a Philco 2000-212, a Datanet 30, and a RAM disc file. (auth)

14719 (UCRL-6798) CONEC—A COUPLED NEUTRONIC-ELASTICITY THEORY CODE AND ITS APPLICATION TO PULSED, FAST REACTORS. O. C. Kolar and Norman Pruvost (California. Univ., Livermore. Lawrence Radiation Lab.). Nov. 1, 1962. Contract W-7405-eng-48. 121p.

A new, coupled, one-dimensional neutronic-elasticity theory code is described. The code was prepared to run on the IBM 7090 digital computer. The calculation is designed for application to pulsed, fast reactors such as Godiva and Super Kukla. The quantities calculated as a function of time and spatial coordinates are: alpha, temperature, radial and tangential stresses, accelerations, velocities, and displacements. Some results of application of CONEC to specific systems are given and compared with the experimental or analytical results. (auth)

14720 ORTHANT PROBABILITIES FOR THE EQUICORRELATED MULTIVARIATE NORMAL DISTRIBUTION. G. P. Steck (Sandia Corp., Albuquerque, N. Mex.). Biometrika, 49: 433-45(1962). (TID-15455; SCR-563)

A review is presented of orthant probabilities in the equicorrelated case, i.e., the probability that n standardized jointly normally distributed random variables are simultaneously positive or negative. A formula is proved for relating orthant probabilities for positive and negative ρ. An accurate approximation is derived for the orthant probability in the case n = 4. Series approximations are also derived for orthant probabilities in higher dimensions useful for ρ near its positive and negative extremes. (D.L.C.)

14721 EVALUATION OF A GENERALIZED ELLIPTIC-TYPE INTEGRAL. Leo F. Epstein and J. H. Hubbell (General Electric Co., Pleasanton, Calif.). J. Res. Natl. Bur. Std., 67B: 1-17(Jan.-Mar. 1963).

Integrals of the form $\Omega_j(k) \equiv \int_0^{\pi} [1 - k^2 \cos \phi]^{-(j+\frac{1}{2})}\, d\phi$, where $0 \leq k < 1$, and j is a positive integer, occur in a radiation field problem. Expressions for $\Omega_0(k)$ and $\Omega_1(k)$ were derived in terms of complete elliptic integrals of the first and second kinds. Using these values, and the recursion formula, $(2j - 1)\,(1 - k^4)\Omega_j(k) = 4(j - 1)\,\Omega_{j-1}(k) - (2j - 3)\,\Omega_{j-2}(k)$, $\Omega_j(k)$ can be found for all values of j and k. A number of useful series expansions and other relations are given for $\Omega_j(k)$, and tables are included for $0 \leq j(1) \leq 9$ and $0 \leq k^2(0.01) \leq 0.99$. (auth)

14722 LINEAR STOCHASTIC OPERATORS. G. Adomian (Hughes Aircraft Co., Culver City, Calif.). Rev. Mod. Phys., 35: 185-207(Jan. 1963).

The properties and use of stochastic operators as a unifying method of dealing with some difficult problems are investigated to gain further insight into the physical interpretation of the theory in some general physical processes. Derivation and interpretation of a stochastic Green's function is outlined, as is treatment of various processes. Evaluation of a stochastic Green's function for a differential operator is also treated. (D.C.W.)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

Refer also to abstract 15472.

14723 (AD-278821) DEVELOPMENT OF PROCESSING METHODS FOR COLUMBIUM ALLOY SHEET. Interim Report No. 1, Covering Period to July 1, 1962. M. Schussler and J. G. Bewley (Haynes Stellite Co., Kokomo, Ind.). Contract AF 33(657)-7210. 25p.

Progress to date on sheet production and evaluation of niobium alloy is summarized. Twenty-eight sheets of niobium base alloy, each 18-inches by 30-inches and in three gages (0.012, 0.018, and 0.030-inches), required under the contract were produced. The fabrication of the sheets and the portion of the evaluation program completed to date on properties of the resultant alloy, HAYNES alloy No. Cb-752, are covered. (auth)

14724 (ARF-2158-15) DEVELOPMENT AND EVALUATION OF HIGH-TEMPERATURE TUNGSTEN ALLOYS. Quarterly Report No. 1, October 1, 1959–December 31, 1959. F. C. Holtz and R. J. Van Thyne (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Jan. 20, 1960. Contract AT(33-3)-4. 15p. (LAR-21)

High-W alloys were prepared by powder metallurgy techniques. Room-temperature strength properties were determined for W–Ni–Fe compositions with quaternary additions of Cr, Pd, and Ru; at W levels of 80 to 94 wt %. Small (1 to 3 wt %) Ru additions were the most effective in improving strength. The oxidation resistance of a number of W-base alloys was measured at 2000°F. Quaternary W–Ni–Fe base alloys containing Al, Ru, Ti, and Zr were the most oxidation resistant, having values similar to unalloyed W. Oxidation protection of a 90W–6Ni–4Fe material was accomplished by a fused coating of AMS 4775; the composite was tested for 482 hr in air at 2000°F without damage to the base alloy. (auth)

14725 (BBC-114) DEVELOPMENT OF INTERMETALLIC COMPOUNDS FOR VERY HIGH TEMPERATURE APPLICATIONS. Quarterly Progress Report, April 1, 1962 through June 30, 1962. R. M. Paine, A. J. Stonehouse, and W. Beaver (Brush Beryllium Co., Cleveland). Aug. 31, 1962. Contract AT(33-3)-20. 38p.

Continuing efforts to investigate the effect of additives on the intermediate-temperature (1000 to 2000°F) problems associated with the beryllides are described. Thermogravimetric oxidation-rate studies and modulus-of-rupture tests are being used to evaluate the properties of the beryllides containing additives. Metallographic examination of polished specimens before and after early stages of oxidation is being used to observe the effect of additives on the oxidation process, and thereby to gain insight as to the mechanisms through which these additives promote oxidation resistance. Additives to $ZrBe_{13}$ such as Al, NiAl, Si, Ni, Sn, and Pt are being studied. The latter two elements did not significantly improve the oxidation resistance of $ZrBe_{13}$, but Si appears to offer considerable promise (in addition to Al and NiAl). Al also affords intermediate-temperature oxidation resistance for Zr_2Be_{17}, and initial studies suggest the same results for $NbBe_{12}$. (auth)

14726 (BM-RI-6195) RADIOTRACER APPLICATIONS IN ELECTROMETALLURGICAL PROCESSING. Kenneth G. Broadhead and Howard H. Heady (Bureau of Mines, Reno Metallurgy Research Center). Sept. 1962. 16p.

Four applications of radiotracer techniques in metallurgical research are described. In electrowinning tungsten from scheelite, Mo^{99} was used to determine the molybdenum concentration of the fused alkali-phosphate bath and the electrowon tungsten. An attempt to determine the solubility of tagged ceric oxide in molten CeF_3-BaF_2-LiF was unsuccessful, but a high rate of cerium ion exchange was observed. Fe^{59} was added to cerium during casting and used to follow the migration of iron during solid state electrolysis. Radiotracers were used in developing special analytical techniques applicable to high-purity rare-earth metals produced by molten salt electrolysis. (auth)

14727 (BMI-1600(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING OCTOBER 1962. Russell W. Dayton and Ronald F. Dickerson (Battelle Memorial Inst., Columbus, Ohio). Nov. 1, 1962. Contract W-7405-eng-92. 83p.

Research and development progress is reported on reactor materials and components, fuel studies, general fuel-element development, radioisotope and radiation applications, development of a system for in-place filter evaluation, materials development and evaluation, coated-particle fuel materials, corrosion studies of fluoride-volatility process, long-term creep-rupture program on SAP alloys, fission product deposition studies, radiation-effects study of candidate fuel materials for the MGCR, irradiation of materials and components, gas-cooled reactor program, process development and evaluation of properties of F-48 niobium alloy, and joining of regenerative cell components. (M.C.G.)

14728 (CEA-2222) MODES D'OBTENTION D'UNE ATMOSPHERE INERTE DANS LES INSTALLATIONS D'ELABORATION DU PLUTONIUM METALLIQUE. (Methods of Obtaining an Inert Atmosphere for Plutonium Metal Treatment Installations). R. Riolfo and M. Barbier (France. Commissariat à l'Energie Atomique. Centre de Production de Plutonium de Marcoule, Chuscian). 1962. 22p.

Pu is a very pyrophoric metal (heat of combustion: 253 kcals/mole). The operations and manipulations involved in its treatment have to be carried out in an inert atmosphere. The reaction $C + O_2 \rightarrow CO_2$ was chosen for O_2 removal. By this method, it is possible to absorb O_2 within a range of concentrations from 0.1 to 20% at 600 to 800°C. (auth)

14729 (CRGM-1106) SOME PRELIMINARY EXPERIMENTS IN THE THERMAL CYCLING OF ZIRCONIUM AND ZIRCONIUM ALLOYS. D. G. Evans (Atomic Energy of Canada Ltd., Chalk River, Ont.). Aug. 1962. 21p. (AECL-1663)

Results of thermal cycling experiments on Zr, Zircaloy-2, and Zr–Nb alloys are presented. The variables examined were preferred orientation, grain size, alloy content and time at temperature. It was found that Zr and Zr-2.9 Nb alloy were dimensionally unstable, whereas a Zr-0.07 Nb alloy was stable. Zircaloy-2 specimens showed variable but small amounts of growth or contraction on thermal cycling. (auth)

14730 (GA-3845) A PROGRAM OF BASIC RESEARCH ON MECHANICAL PROPERTIES OF REACTOR MATERIALS. Quarterly Progress Report, Period Ending Decem-

ber 31, 1962. T. A. Trozera, R. H. Chambers, and J. L. White (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Feb. 8, 1963. Contract AT(04-3)-167. 24p.

An etch-pitting technique for studying deformations and fabrication characteristics of tantalum is discussed. A series of measurements of the temperature dependence of the amplitude-dependent modulus defect in well-annealed, high purity niobium wire is described. The colorimetric technique for obtaining stored-energy-release spectra on deformed iron is presented. (H.G.G.)

14731 (GEAP-3979) SPECIFIC ZIRCONIUM ALLOY DESIGN PROGRAM. First Quarterly Progress Report, February–June 1962. H. H. Klepfer, D. L. Douglass, and J. S. Armijo (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). July 1, 1962. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(04-3)-189. 124p. (EURAEC-422)

A program was initiated for the design of steam-service Zr base cladding alloy. Specifications were derived for an acceptable alloy for such service based on considerations of neutron economy, cost, H_2 embrittlement, corrosion resistance, fabricability, and strength. The selection of the field of alloy compositions having promise for meeting these specifications was made. Thirty-one alloys whose compositions were chosen from the alloy field were arc-melted and are being fabricated to sheet. Specimens cut from the sheet will be tested for response to composition. The response parameters will measure corrosion resistance at 300, 400, and 500°C, mechanical properties before and after corrosion exposure, and H_2 take-up during corrosion. The experiment is designed to permit analysis of the results employing computer programing to determine the optimum composition within the selected alloy field. Fundamental studies in support of the alloy design were also initiated. Film stripping techniques were developed to permit partitioning studies of alloying element between the corrosion film and the alloy substrate. Hydrogen overvoltage measurements were made for the intermetallic phases Zr_2Cu, Zr_2Ni, for Zr–90% Nb and for crystal bar Zr. The diffusion of O_2 in bulk nonstoichiometric ZrO_2 was measured: $D = 0.055 \exp (33{,}400 \pm 3{,}100/RT)$ for $ZrO_{1.955}$ at 700 to 1000°C. The activation energy is in agreement with that for parabolic corrosion of Zr alloys indicating that bulk O_2 diffusion in the corrosion films and not short circuiting diffusion paths are rate controlling. Oxygen diffusion in alloy oxide-doped ZrO_2 is now being studied. (auth)

14732 (GEAP-4051) PROGRAM FOR THE DEVELOPMENT OF PLUTONIUM RECYCLE FOR USE IN LIGHT WATER MODERATED REACTORS. Fifth Quarterly Report, April 1–June 30, 1962. J. G. Carver, W. R. Morgan, and M. A. Robkin (General Electric Co. Vallecitos Atomic Power Lab., San Jose, Calif.). July 15, 1962. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(04-3)-189. 11p. (EURAEC-454)

The Program fuel element has achieved an estimated burnup of 780 Mwd/t at the center of the Pu fuel, for a cumulative burnup of approximately 1,640 Mwd/t. Thermal energy group transfer cross sections for UO_2 were computed and found to exhibit a strong dependence on fuel temperature. Neutron spectra within a rodded cell of the fuel element are being calculated through the use of two distinct scattering models; the calculations are complete for the case in which UO_2 scattering is ignored, and in progress for the case in which it is included. Data were reduced from the resonance wire activations performed last quarter in the Program fuel element. Results of analyses concerning the ratios between the activation rates in Lu, Cu, and Au indicate that the thermal spectrum is harder in the Pu-enriched part of the fuel element than in the U portion. It was found that at locations only 1.5 in. apart in a horizontal plane different spectra were in being. Plans for a recheck of this result are discussed along with other plans for future research. (J.R.D.)

14733 (GEAP-4058) ANALYTICAL STUDIES OF TRANSIENT EFFECTS IN FAST REACTOR FUELS. [PART] I. R. B. Osborne and D. B. Sherer (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Aug. 1962. Contract AT(04-2)-189. 55p.

An experimental program to evaluate the performance of Fast Ceramic Reactor (FCR) and Experimental Fast Ceramic Reactor (EFCR) fuel during transient operation is outlined and possible mechanisms of failure are analyzed. The analysis involved evaluation of temperature levels and gradients, fuel element internal pressure, differential thermal expansion in various parts of the fuel, and the resultant deformation that may occur in either normal operating transients or accidental power excursions. With a NaK coolant, the mechanism for transient fuel failure in EFCR is likely to be coolant boiling unless severe local stress concentrations exist. With a Na coolant, in either EFCR or FCR, the failure mechanism is more likely to be internal pressure due to fission gas and/or fuel vapor pressure and is thus directly dependent on fuel temperatures. (auth)

14734 (IGO-TM/CA.010) NICKEL PLATING BY THE CHEMICAL (ELECTROLESS) PROCESS. M. J. Charles (United Kingdom Atomic Energy Authority. Industrial Group. Capenhurst Works, Capenhurst, Ches., England). July 1957. 10p.

An outline is presented of the chemistry and technology of the process which has proved extremely useful on a laboratory scale at Capenhurst for the production of nickel plated apparatus with a high degree of corrosion resistance. A bibliography is included. (auth)

14735 (KR-31) ALUMINIUM AS CANNING MATERIAL IN WATER COOLED POWER REACTORS. Steinar Aas and Ketil Videm (Norway. Institutt for Atomenergi, Kjeller). Oct. 1962. 26p.

It is shown that aluminum as a canning material will reduce the fuel cost in a boiling heavy water reactor by 0.1 to 0.4 mills/kwh depending upon wall thickness, enrichment, and other factors. A first analysis of the corrosion and mechanical properties of an Al-10 wt % Si, 1 wt % Mg, 1 wt % Ni alloy shows that it appears satisfactory for in-pile use. It is pointed out, however, that there is still much work to be done before a reliable, rational, and economical fuel element design can be presented. (auth)

14736 (NAA-SR-Memo-7839) PREIRRADIATION MEASUREMENTS OF PIQUA FUEL ELEMENTS NO. P-1111, P-1113, P-1114, AND P-1120. H. J. Hubbell (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 6, 1962. Contract [AT (11-1)-Gen-8]. 68p.

Results of preirradiation measurements and tests performed during the processing and assembly of the individual fuel cylinders contained in Piqua Fuel Elements No. P-1111, P-1113, P-1114, and P-1120 are presented. A description of the techniques and equipment used in obtaining the data is also included. (auth)

14737 (NMI-7258) POWER REACTOR PROGRAM. Progress Report to Savannah River Operations Office, United States Atomic Energy Commission for the Period

December 1, 1962–December 31, 1962. S. Isserow, R. W. Anderson, D. M. Davies, A. R. Gilman, and A. B. Bremer (Nuclear Metals, Inc., West Concord, Mass.). Jan. 31, 1963. Contract [AT(30-1)-1565]. 19p.

Three U–350-ppm Fe–900-ppm Al tubes were coextruded in Zircaloy-2 as part of the program to develop improved fuel materials. Short specimens for irradiation in the HWCTR are to be prepared from these tubes and the previously prepared unalloyed uranium tubes. Measurements of hardness over 32 hours at 550°C indicated that the hardening effect of either 200-ppm Si or 500-ppm Cr on beta quenched U–350-ppm Fe–900-ppm Al is reduced at the same rate. Hardness tests indicated that the combination of Si and Cr additions contributes little if anything to the hot hardness of U–Fe–Al beyond any individual effects of the Si or Cr. An alloy of U–350-ppm Fe–900-ppm Al–400-ppm Si–1000-ppm Mo was cast and coextruded in Zircaloy-2 in an effort to combine the hardening effects of Si and Mo in the U–Fe–Al composition. Extrusion data indicate that the alloy is significantly stiffer than U–Fe–Al at 600°C. A technique was established for the brazing of end closures on unalloyed U tubes for the HWCTR. Both ultrasonic and destructive tests were used to evaluate the soundness of the brazes. For the adaptation of the fabrication process to the driver tubes of new design, the coextrusion temperature of 1380°F was selected on the basis of hot hardness tests and experimental extrusions. Various billet components are being prepared for the first two experimental tubes, one inner and one outer. The C contents of the Zircaloy-U billet cores are being minimized by modifying the heating cycle in the melting. (auth)

14738 (NMI-9525) BERYLLIUM RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report to Aeronautical Systems Division, July 1, 1962–September 30, 1962. S. H. Gelles (Nuclear Metals, Inc., Concord, Mass.). Jan. 28, 1963. 60p. Contract AF33(616)-7065.

Progress on the Beryllium Research and Development Program is reported. Topics covered include: studies of brittle behavior of beryllium by transmission electron microscopy, metallurgical factors affecting the ductile-brittle transition in beryllium, preparation of ultra-fine beryllium powder, preparation and evaluation of fine-grained beryllium, recrystallization and grain growth in beryllium, identification of impurities and precipitates in beryllium, preparation and evaluation of high-purity beryllium, and fabrication and evaluation of fine-grain beryllium produced from ultra-fine powders. (M.C.G.)

14739 (NP-12525) DEFENSE METALS INFORMATION CENTER SELECTED ACCESSIONS. Patricia B. Plate, comp. (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Jan. 1963. Contract AF33(616)-7747. 46p.

A listing of selected documents and journal articles in abstracted form for January 1963 on high-strength alloys, light metals, non-metallics, refractory metals, coating, applications, and composites is presented. Author, subject, and DMIC numerical indexes are included. (M.C.G.)

14740 (TID-11295(2nd Ed.)) NUCLEAR FUELS AND MATERIALS DEVELOPMENT. (Division of Reactor Development, AEC). Sept. 1962. 461p.

A summary is presented of work being done in 1961 under the Nuclear Technology program of the Division of Reactor Development. Some U.S.-EURATOM projects are also described. The summary is divided into sections dealing with fuel and fertile materials, cladding and structural materials, control rod materials, moderator materials, fabrication technology, physical and mechanical properties, and nondestructive testing. (D.L.C.)

14741 (TID-17594) INVESTIGATIONS OF RADIOACTIVE FUEL-BEARING GLASSES. First Annual Report, January 1, 1958–September 30, 1958. P. A. Lockwood (Owens-Corning Fiberglas Corp. Basic and Applied Research Center, Newark, Ohio). For Rensselaer Polytechnic Inst., Troy, N. Y. Contract AT(30-1)-1995, Subcontract R.P.I. 441.37-1. 55p.

The Glass Research Laboratory has developed several glasses which show considerable promise for use in both chemical process and power reactor materials. Glasses containing from 10 to 55 wt % U_3O_8 were developed and formed into fibers. Several glasses containing between 30 and 50 per cent U_3O_8 proved to be especially suitable for reactor uses. Studies were initiated in the leaching of glasses containing low percentages of uranium whereby one constituent is leached out to increase the total uranium content. The leaching technique produced several high temperature fibers which could not be formed by other methods. Several of the glasses developed were coated with aluminum during the fiber forming operation and the aluminum-coated fibers were made into composites by hot pressing or vacuum casting. A technique was developed by which the vacuum cast and hot pressed materials containing high percentages of glass can be rolled into plates. These uranium-bearing glass-metal composites were then placed between sheets of pure aluminum and hot rolled to form small, sample fuel element plates. (auth)

14742 (TID-17595) INVESTIGATIONS OF RADIOACTIVE FUEL-BEARING GLASSES. Second Annual Report, April 1, 1959–March 31, 1960. P. A. Lockwood (Owens-Corning Fiberglas Corp. Basic and Applied Research Center, Newark, Ohio). June 30, 1960. For Rensselaer Polytechnic Inst., Troy, N. Y. Contract AT(30-1)-1995, Subcontract R.P.I. 441.37-1. 33p.

Effects of processing variables on strength of fibers of silica-urania glasses made by acid leaching are reported. Composition and melting studies to eliminate UO_2 devitrification in RX-70 glass (50% U_3O_8 by weight) resulted in little improvement. Liquidus was 2470°F and sensitive. Forming fibers at 2500 to 2550°F should avoid most of the difficulty. Samples of glass fibers were made for use in gas phase chemical reaction promotion and gas-cooled power reactor studies; for fuel element work; and for basic research studies. The samples comprised: natural and U^{235} enriched urania glass fibers, plain and aluminum coated; plate glass fibers, aluminum coated; "E" glass-clad urania and cobalt glass fibers; mats of air blown fibers, U^{235} enriched, loaded into fuel element cans. A practical glove box for melting and fiberizing plutonium-containing glass was designed. Losses of U^{235} in laboratory batching, melting, and fiberizing procedures for urania glasses were found to be 3 to 7%, well above the 1% previously assumed. Methods of analyzing glass for U_3O_8 content were investigated. (auth)

14743 (WAPD-T-1427) THE ANNEALING OF IODIDE HAFNIUM. J. G. Goodwin (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Mar. 16, 1962. Contract AT-11-1-GEN-14. 28p.

The effects of heat treatments on the hardness of cold rolled hafnium is described. Equations and curves for predicting hardness after heat treatments of varying periods of time at temperatures of 750, 800, and 850°C for cold reductions up to 25% in 5% increments are presented. Other curves are provided that estimate annealing times

in the temperature range 850 to 950°C. Data were utilized to estimate activation energies for the annealing process. (H.G.G.)

14744 (WAPD-T-1549) THE DEVELOPMENT OF THE ZIRCALOYS. Stanley Kass (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Oct. 1962. Contract AT(11-1)-Gen-14. 48p.

The experimental work leading to the development of Zircaloys -1, -2, -3, and -4 are reviewed. The corrosion properties of Zircaloys-2 and -4 in high temperature water and steam and the effects of composition, heat treatment, and water chemistry upon oxide film formation and hydrogen absorption during corrosion are discussed. (auth)

14745 (AEC-tr-5663) A SENSITIVE METHOD FOR THE DETERMINATION OF DIFFUSION COEFFICIENTS. V. A. Geodakyan and A. A. Zhukhovitskii (Zhukhovitsky). Translated by H. J. deBruin (Oak Ridge National Lab., Tenn.) from Zh. Fiz. Khim., 31: 2295-2301(1957). 10p.

A new method developed for the determination of diffusion coefficients with the advantages of high sensitivity, simplicity, and universality of nature of radiation is described. Self-diffusion coefficients for silver and iron are measured. (H.G.G.)

14746 (AEC-tr-5667) ITEM I—SOLUTION OF STAINLESS STEEL CLADDING. Progress Report, April 1, 1962. (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). Translated for Oak Ridge National Lab., Tenn. from report DM.T.329-N. Apr. 4, 1962. 95p.

Activities in a program to develop stable, stainless steel-clad, UO_2 fuel elements are reported. Results of investigations concerning cladding behavior in areas such as cracking, diametric deformation, corrosion, and those associated with fabrication in relation to temperatures up to 700°C are given. Information is also included concerning fuel rod development and assembly of 19-rod clusters. (J.R.D.)

14747 (AEC-tr-5677) SOME ALLOYS OF CERIUM AND LANTHANUM. W. Muthmann and H. Beck. Translated from Ann. Chem. 331: 46-57(1904). 9p.

Detailed information concerning the methods of alloying pure Ce and pure La with other metals and the properties of these alloys is presented. Efforts to alloy Ce or La with Sn or Pb were unsuccessful. (H.G.G.)

14748 (AERE-Trans-899) SINTERING THEORY AND EFFECTS IN THE POWDER METALLURGY OF THERMOELECTRIC MATERIALS. H. Schreiner and F. Wendler. Translated by D. P. Donnelly (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Z. Metallk., 52: 218-28(1961). 29p.

Sintering force theories and the mechanisms responsible for substance transport during sintering processes are discussed. The vacancy diffusion mechanism must be considered when sintering theories are applied to semiconductors. The production of thermoelectric materials by powder metallurgical methods depends mainly on the fabrication process. Thermoelectric properties are not only influenced by the material and its composition but mostly by its structure. Different powder metallurgical fabrication methods for the production of sintered semiconductors are described. It is desirable to obtain the highest possible sinter or final density together with the optimum thermoelectric properties. The influence of compacting pressure and sintering temperature on sintering density has been studied. Data are presented which show possibilities of cold compacting the compound Bi_2Te_3. The drop of density under certain working conditions is discussed. (auth)

14749 (EURAEC-408) USE OF PLUTONIUM AS A FUEL IN NUCLEAR REACTORS. Quarterly Report No. 8, April 1–June 30, 1962. (Brussels. Centre d'Etude de l'Énergie Nucléaire and Société Belge pour l'Industrie Nucléaire, Brussels). July 1962. Work Performed Under United States–Euratom Joint Research and Development Program. Contract 027-60-7RDB. 129p. A translation. (BN-6207-02)

Includes Appendix: PERFECTING OF A METHOD OF DETERMINING SPECIFIC SURFACES WHICH COULD BE APPLIED TO PLUTONIFEROUS CERAMIC FUELS. Quarterly Report No. 8. Final Report. (Société Belge pour l'Industrie Nucléaire, Brussels).

Work on powder preparation showed that plutonium peroxide precipitation requires excess H_2O_2. Reduction of density variations in vibration-compacted plutonium oxide powders using a method developed for U specimens is reported. Higher densities were obtained by the use of larger-grained powders compacted by vibration. In powder characterization work it was found that CO cannot be used in oxide reduction for oxygen analysis. Radiocrystallographic work consistently gives slightly higher crystalline parameters than those resulting from the Végard law. The melting point of Pu_2O_3 (or the temperature of a Pu_2O_3–PuO_2 eutectic) is about 1780°C. In carbide work it was found that PuO_2 is reduced at about 1400°C, and the formation of carbide begins at about 1550°C. In other work, the preparation of spherical carbide fuel pellets is reported along with the preparation of Mo–U dispersions of 93% TD by swaging. It was also shown that U–8 to 12% Mo alloys can be reduced to powder by hydridation if the α phase is present. Results of a study concerning Cr–Nb–Zr and Nb–V–Zr alloys are presented which indicate that to avoid transformation to Zr–Nb alloys in the V alloy, a larger proportion of V than Nb is necessary. The Cr alloy showed a suppression of the transformation at 600°C, and all samples had a higher Nb than Cr content. (J.R.D.)

14750 (EURAEC-459) WELDING OF VERY THICK STEELS. Quarterly Report No. 4, July 1 to September 30, 1962. (Ghent. Rijksuniversiteit; Soudometal, S. A., Brussels). Work Performed under United States–Euratom Joint Research and Development Program. Contract 042-61-9 RDB. 208p. A translation.

The mechanical properties of thick joints welded manually, studies of SOUDOTENAX-56 basic steel, automatic welding, relaxation annealing of SOUDOMETAL-56 steel, and studies of 30 and 100 mm plates were studied. Activities and results associated with these programs are detailed. (J.R.D.)

14751 (EURAEC-478) SINTERED URANIUM OXIDE: SINTERING TECHNIQUES—BEHAVIOR UNDER IRRADIATION. Quarterly Report No. 8, July 1–September 30, 1962. (France. Commissariat a l'Energie Atomique, Paris). Work Performed under United States–Euratom Joint Research and Development Program. Contract 031-60-10RDF. 51p. A translation.

Results of powder sintering at 1300°C in H_2 show that 94.5% of TD can be obtained in moist atmospheres. Accelerated sintering at 1600 was found to produce higher densities and more homogeneous texture, however the effects of raw density appear to be very critical. Cooling of sintered UO_2 in H_2 atmospheres containing small quantities of O_2 is accompanied by formation of thin layers of U_4O_9 which progresses along grain joints causing their loosen-

ing. In studies concerning fission gas liberation from UO_2, a measuring method for the specific surfaces of small samples is proposed using Xe^{133} and Hg^{203}. Experiments in which the absorption of Hg was tested were successful. Preliminary results using Xe^{133} are being evaluated. Other work is reported on development of isothermal measuring techniques and development of the Medicis out-of-pile loop. (J.R.D.)

14752 (EURAEC-490) USE OF PLUTONIUM AS A FUEL IN NUCLEAR REACTORS. Quarterly Report No. 9, July 1–September 30, 1962. (Brussels. Centre d'Etude de l'Energie Nucleaire and Société Belge pour l'Industrie Nucléaire, Brussels). Oct. 1962. Work Performed under United States–Euratom Joint Research and Development Program. Contract 027-60-7 RDB. 49p. A translation.

Research revealed that calcined plutonium peroxide precipitates are less sinterable but are composed of more perfect crystals than those obtained from oxalate precipitates. Other information concerning vibratory compaction of fuel in units, swaging operations, and welding is included along with information on characterization of PuO_2–UO_2 composites, carburization of Pu–U mixed oxides, development dispersion elements, electrochemical determination of Pu and U, and Pu recycling. (J.R.D.)

14753 SPECIAL MATERIALS FOR REACTOR CONSTRUCTION AND THEIR METHODS OF FABRICATION. S. H. Bush (General Electric Co., Richland, Wash.). At. Energy Rev., 1: No. 1, 43-92(1963). (In English)

A survey is made of the literature dealing with the materials used in nuclear reactors and the methods of fabrication of these materials into reactor components. The reactor concepts examined are those for civilian power generation; coolants include water, deuterium oxide, sodium, organic liquids, or gases. The reactor components considered are the pressure vessel, pressure tubes, primary coolant piping, calandrias, grids, heat exchangers and steam generators, and other internal "hardware" (valves, pumps, gaskets, bolts, etc.). The structural materials used for these component applications are examined. Methods of component fabrication are reported when they are believed to represent major changes or advances. Particular emphasis is given to the joining of materials. Also, trends in materials and methods of fabrication are analyzed to anticipate limitations in the use of materials. Concrete, laminated, and alloy-steel pressure vessels are discussed within the framework of future trends. Possible limitations of high-temperature alloys as a result of radiation effects are considered to the extent that they influence the design of reactor components. (auth)

14754 FUEL MATERIAL AND FUEL ELEMENT DEVELOPMENT. R. A. Van Der Laken, P. F. Sens, and J. H. N. Verheugen. Atoomenergie Haar Toepassingen, 4: 284-7(Nov. 1962). (In English)

Facilities for the preparation and testing of UO_2 fuels are discussed. The development and testing of UO_2 PWR-type fuel elements are also outlined, including hydraulic, corrosion, and in-pile testing. (T.F.H.)

14755 THE DEVELOPMENT OF PLUTONIUM-CONTAINING CERAMIC FUELS. K. A. Nater and B. Verkerk. Atoomenergie Haar Toepassingen, 4: 291-2(Nov. 1962). (In English)

A description is given of a laboratory for the preparation and testing of $(Pu,U)O_2$ fuel elements. (T.F.H.)

14756 ZONE FUSION AND ACTIVATION ANALYSIS. J. Petit, B. Schaub, and Ch. Engelmann. Bull. Inform. Sci. Tech. (Paris), No. 62, 39-42(June 1962). (In French)

A brief review is made of the progress made by the C.E.A. in the study of activation analysis, fusion by electron bombardment, and zone fusion of beryllium. (J.S.R.)

14757 BEHAVIOR OF HELIUM IN BERYLLIUM. V. Levy. Bull. Inform. Sci. Tech. (Paris), No. 62, 56-9 (June 1962). (In French)

The irradiation of Be by neutrons leads to the formation of considerable quantities of helium. The presence of He in the Be greatly modifies its properties. The principal results obtained in the study of the effects of He inclusions on the properties of Be are summarized. The study methods used were density measurements, optical microscopy, and electron microscopy. Density measurements show that there is no appreciable swelling at temperatures below 800°C. The law of volume variation as a function of the temperature seems to indicate a swelling process having an activation energy of 45 kcal/mol. Micrographic examinations have shown that if the irradiation temperature is sufficiently low the samples show no gas bubbles. With temperature increase, bubbles are formed. The dimensions of the bubbles depend strongly on the temperature of the thermal treatment. Temperature increase, in addition to causing an increase of the bubble dimensions, also causes a decrease in the number of bubbles per cm^2. The bubbles are located preferentially along dislocations or on grain boundaries. The presence of these bubbles causes an important variation in the mechanical properties of Be. (tr-auth)

14758 VAPORIZATION UNDER VACUUM OF URANIUM. Wiley-Jean Deiss (Centre d'Études Nucléaires, Grenoble, France). Compt. Rend., 256: 671-3(Jan. 14, 1963). (In French)

It is known that the principal obstacle in obtaining thin films of uranium by vacuum evaporation is the high oxidation of this metal by the residual oxygen in the vessel. Some workers have therefore, logically, operated under ultra-vacuum in order to lower the partial pressure of oxygen. A method is proposed which makes use of the deoxidizing action of carbon added to the metal to be evaporated. The thermodynamic and kinetic oxidation conditions for uranium under vacuum were examined first. (tr-auth)

14759 LIQUID METALS—THEIR PROPERTIES, HANDLING, AND APPLICATIONS. C. B. Jackson and J. W. Mausteller (MSA Research Corp., Callery, Penna.). Mod. Mat., Advan. Develop. Appl., 3: 401-52(1962).

A review is presented of liquid metals, which are defined to be metals having melting points equal to or less than that of aluminum (660.2°C). The properties that are summarized in detail include chemical and physical properties, reactions with air, and nuclear properties. The heat transfer of liquid metals is also reviewed. Operational procedures and equipment for application of liquid metals are discussed, and some of these applications are described. (D.L.C.)

14760 PREPARATION BY ELECTRO-SPRAYING OF THIN URANIUM, PLUTONIUM AND BORON SAMPLES FOR NEUTRON CROSS SECTION MEASUREMENTS IN 4π GEOMETRY. K. F. Lauer and V. Verdingh (Euratom, Geel, Belg.). Nucl. Instr. Methods, 21: 161-6(Jan. 1963). (In English)

The preparation of thin films is an important requirement for many measurements in nuclear physics. If the required surface is large, the problem is furthermore complicated. A machine and a technique are described which allow to prepare samples with a diameter of up to 5 cm. The method was applied to uranium, plutonium, and boron. (auth)

14761 THE QUALITY CONTROL OF THE CONCRETE OF THE FINNISH RESEARCH AND TRAINING REACTOR FIR 1. Report Partially Translated into English. S. E. Pihlajavaara and Esko Pihlman. Valtion Tek. Tutkimuslaitos, Tiedoitus, Serja III, No. 62, 1-50(1962). (In Finnish and English)

A description is given of the methods and results of fabrication and testing of concrete for the FiR 1 reactor. (D.L.C.)

14762 RECOMMENDATIONS FOR RADIATION-SHIELDING CONCRETE STRUCTURES. Arvo Nykaenen and S. E. Pihlajavaara. Valtion Tek. Tutkimuslaitos, Tiedotus, Sarja III, No. 65, 1-8(1962). (In Finnish)

Recommendations are given for the design, construction, and control of radiation-shielding concrete structures. The planning of the structures is outlined. The effects of density, composition, and water content of the concrete on its gamma and neutron attenuation efficiencies are discussed. (D.L.C.)

Corrosion

Refer also to abstract 14173.

14763 (BMI-X-218) CORROSION OF THE ORNL-VPP-MARK 3 FLUORINATOR AND GROUP V RODS. P. D. Miller, E. L. White, J. D. Jackson, W. K. Boyd, W. N. Stiegelmeyer, and F. W. Fink (Battelle Memorial Inst., Columbus, Ohio). Feb. 15, 1963. Contract [W-7405-eng-92]. 39p.

The results of a corrosion evaluation of two discs trepanned from the "L"-nickel Mark 3 fluorinator and of ¼-in. corrosion rods of six alloys exposed in the same vessel are summarized. A corrosion study was also made of alloys subjected to cyclic exposures to solutions and conditions simulating those used in decontaminating the pilot plant. In the fluorinator, accelerated attack at the interface of the base metal and weldment was clearly evident. The attack on the "L"-nickel-base metal was intergranular in nature and extended to an average depth of 6 mils and a maximum of 22 mils. Rods of nickel and nickel alloys exposed in the fluorinator showed high corrosion rates. The studies of the corrosive effects of decontaminating solutions showed that a loss of about 7 mils is due to the decontaminating procedure. (M.C.G.)

14764 (BMI-X-10030) DEVELOPMENT OF NIOBIUM-BASE ALLOYS FOR USE IN A NUCLEAR SUPERHEATER. Quarterly Progress Report, October–December 1962. John A. DeMastry, Authur A. Bauer, and Frank A. Rough (Battelle Memorial Inst., Columbus, Ohio). Jan. 1, 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract W-7405-eng-92. 8p. (EURAEC-546)

The development and evaluation of niobium-base alloys resistant to 1000 to 1300°F steam for structural or cladding applications in a nuclear superheater are discussed. Thirty-nine experimental alloys containing aluminum, iron, molybdenum, titanium, vanadium, and zirconium were exposed to 1000°F 1500-psi steam for 56 days. The addition of titanium and vanadium appeared to be beneficial to corrosion resistance while aluminum, iron, molybdenum, and zirconium were not. The value of the addition of chromium was uncertain. A second series of binary niobium alloys containing titanium and vanadium, and of ternary and quaternary alloys containing chromium, molybdenum, titanium, and vanadium were prepared and are currently being tested. Comparison of the corrosion behavior of cold-worked and annealed alloys indicated that cold work (90 per cent reduction in thickness) increases the corrosion resistance of niobium alloys. The addition of either molybdenum or vanadium to niobium appeared beneficial when the alloys are cold worked. For cold-worked alloys containing vanadium and/or titanium, the addition of 6 to 9 at. % chromium appeared to impart improved corrosion resistance. One alloy (niobium-21 at. % titanium-12 at. % vanadium-9 at. % chromium) exhibited a weight gain of only 116 mg per dm^2 after 56 days of exposure to 1000°F steam. Sixteen additional alloys containing chromium, molybdenum, titanium, and vanadium were prepared to study the effects of these additions on the corrosion resistance of niobium more fully. (auth)

14765 (BNL-736) URANIUM–BISMUTH IN-PILE CORROSION TEST LOOP. RADIATION LOOP NO. 1. C. H. Waide, L. E. Kukacka, R. A. Meyer, J. Milau, J. H. Klein, J. G. Y. Chow, C. J. Klamut, and D. H. Gurinsky (Brookhaven National Lab., Upton, N. Y.). May 1961. Contract AT-30-2-GEN-16. 40p. (BNL-T-265)

A loop was operated in the Brookhaven Graphite Research Reactor to determine the effect of in-pile irradiation on the corrosion of various materials by a U–Bi solution. The loop was fabricated of 2¼% chrome-1% Mo steel and contained, in the in-pile section, specimens of low-chrome steels, C steel, Mo, Be, Ta, and graphite. The U–Bi solution containing 869 ppm U^{235}, 98 ppm U^{238}, 236 ppm Zr, and 346 ppm Mg was circulated at 5¼ gpm. A temperature difference of 75°C was maintained on the loop. The in-pile test section ran at 500°C and the finned cooler section at 425°C. The in-pile test section was exposed to a neutron flux of 4.4×10^{12} neutrons/cm^2-sec which provided a fission density of 5.5×10^{10} fissions/cm^3-sec. Metallographic examination indicated that the corrosion and/or erosion of the steel and graphite specimens was nil. Wetting of the specimens by the U–Bi solution was limited. Results indicate that in-pile and out-of-pile experimental results are similar and that fission fragment recoils did not contribute materially to either wetting or corrosion under the conditions imposed in this test. (auth)

14766 (HW-73697) PRTR PRESSURE TUBE MONITORING RESULTS IN-REACTOR INSPECTION, NOVEMBER 1962. D. R. Doman and P. J. Pankaskie (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 20, 1962. Contract AT(45-1)-1350. 4p.

Nondestructive inspections of the PRTR Zircaloy-2 pressure tubes in situ were made as part of the monitoring program to evaluate this alloy as pressure tube material. Results of in-reactor monitoring inspections of several tubes made after reactor decontamination are presented. (J.R.D.)

14767 (IDO-14600) CORROSION EVALUATION OF STAINLESS STEELS EXPOSED IN ICPP HIGH-LEVEL RADIOACTIVE WASTE TANKS. T. L. Hoffman (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Dec. 26, 1962. Contract AT(10-1)-205. 25p.

Several 300 series stainless steels were corrosion tested in raffinate storage tanks made of the same materials. After exposure to the raffinate solutions for periods of up to seven years, maximum penetration rates of 0.1 mil/yr were noted. (auth)

14768 (MSAR-63-33) EFFECT OF 1200°F SODIUM ON AUSTENITIC AND FERRITIC STEELS. Progress Re-

port No. 29, January 1963. (MSA Research Corp., Callery, Penna.). Feb. 15, 1963. Contract AT(11-1)-765. 40p.

Completion of stainless steel fatigue tests in air and liquid Na is reported. Rupture tests in air are in progress. Stainless steel creep tests in Na were terminated after 4000 hrs. Fatigue, rupture, and creep tests on Cr–Mo steel are reported. Analytical results are included on specimens of Na from loops 1 and 2, C solubility and solution rates in Na, and molten Na carbonate content. Results of metallurgical examination of stainless steel and Cr–Mo–C steel specimens are included along with tabulated data obtained in the fatigue, tensile, and stress-rupture tests. (J.R.D.)

14769 (NMI-1908) BERYLLIUM CORROSION. Quarterly Report to United States Atomic Energy Commission for the Period September 25, 1962 to December 31, 1962. D. S. Kneppel (Nuclear Metals, Inc., West Concord, Mass.). Jan. 23, 1963. Work performed under United States–Euratom Joint Research and Development Program. Contract AT(30-1)-3012. 19p. (EURAEC-579)

Additional testing of samples of hot-pressed beryllium prepared from CR-grade powder (–200 mesh) confirmed that the higher purity beryllium shows poor corrosion resistance. Samples of extruded Brush QMV powder survived 162 days in 343°C water. Additional exposure resulted in accelerated corrosion. However, the indications are that the sudden breakdown in corrosion resistance may be due to some variable in the testing conditions. Samples exposed in water with a pH of over 8 generally exhibit poor corrosion resistance. However, lowering the pH did not insure good corrosion resistance. Failure of the samples in the autoclave shows no correlation with final pH. Contact of beryllium with stainless steel, platinum, zirconium, and Zircaloy-2 produced no evidence of any gross galvanic corrosion in high temperature water. Evidence was obtained that the occurrence of boiling on the surface of samples exposed in high temperature water is a cause of accelerated attack. However, water corrosion tests in autoclaves overpressurized with argon showed that failures still can occur. Metallic impurity additions were made to CR-grade (–200 mesh) powder by blending of the elemental powders for the purpose of determining which impurities are responsible for the improved corrosion resistance of beryllium prepared from the less pure commercial powders. (auth)

14770 (TID-15970) DIRECT OBSERVATION OF THE OXIDATION OF ALUMINUM SINGLE CRYSTAL SURFACES. P. E. Doherty and R. S. Davis (Little (Arthur D.) Inc., Cambridge, Mass.). May 1962. Contract AT(30-1)-2756. 29p.

A new technique was developed by which naturally- and anodically-formed aluminum oxide produced on single crystal specimens was studied in the electron microscope. The low-temperature amorphous oxide that grows by the transport of cations is smooth at the metal-oxide interface. However, the oxide:oxygen interface exhibited topography on certain crystal orientations. A high-temperature crystalline oxide was found to grow by the transport of anions. Epitaxial growth was observed on several orientations. The anisotropy of oxide thickness which occurs at elevated temperatures is discussed. The above results are considered in terms of the structure of the metal-oxide interface. (auth)

14771 (TID-16092) CHEMICAL ANALYSIS OF STAINLESS STEEL CORROSION PRODUCTS. J. R. Ciaranello and K. E. Combs (Knolls Atomic Power Lab., Schenectady, N. Y.). [1959]. Contract [W-31-109-eng-52]. 3p.

A synopis of colorimetric procedures used for the determination and analysis of the corrosion products derived from stainless steel is presented. The chief corrosion product is Fe_3O_4, which represents ~50% of the sample. Other major elements are nickel, chromium, manganese, cobalt, zirconium, copper, and zinc. (H.G.G.)

14772 (TID-17913) CATHODIC PROTECTION OF AMPHOTERIC METALS. [Cornelius Groot] (Knolls Atomic Power Lab., Schenectady, N. Y.). [1962]. Contract [W-31-109-eng-52]. 19p.

Cathodic protection is defined by potential. Amphoteric metals are defined by solubility of the oxide as a function of pH. Cathodic protection of amphoteric metals is discussed in terms of potential-pH diagrams. Cathodic protection for Al is shown to be possible in acid solutions, cathodic corrosion in basic solutions. Cathodic corrosion and anodic protection have long been observed. Whether cathodic protection is possible in a given system must be determined by experiment. The potential-pH diagram for Fe is much more favorable for cathodic protection. (auth)

14773 (TID-18063) HIGH TEMPERATURE OXIDATION OF RARE EARTH METALS. Final Technical Progress Report. Karl S. Vorres (Miami, Fla. Univ., Coral Gables). Jan. 1963. Contract AT(40-1)-2853. 9p.

Rare earth metals were oxidized under carefully controlled conditions of time, temperature, and gas pressure to obtain information on the rate of oxide formation, the structure of the oxides formed under these different conditions, and to determine the mechanism of oxide formation under each of the varied conditions used. Results of these experiments are presented. (H.G.G.)

14774 (AEC-tr-5646) INFLUENCE OF SILICON ADDITIONS ON THE CORROSION OF CHROMIUM–NICKEL AUSTENITIC STEELS IN NITRIC MEDIUM CONTAINING HEXAVELENT CHROMIUM. H. Coriou, A. Desestret, L. Grall, and J. Hockmann. Translated by Myra S. Feldman (Savannah River Lab., E. I. Du Pont de Nemours and Co., Aiken, S. C.) from Compt. Rend., 254: 4467-9 (June 25, 1962). 4p.

A study of the effects of composition on the behavior of Cr–Ni austenitic stainless steels in HNO_3 with chromic anhydride added was conducted. The effects of Si additions in excess of 2% were examined. Corrosion resistance of the alloy in HNO_3 containing Cr-III was better at low Si content, while in the presence of Cr-IV the high-Si alloy was more resistant. (J.R.D.)

14775 THE COMPATIBILITY OF BERYLLIUM WITH CARBON DIOXIDE AT HIGH TEMPERATURES. R. Darras (Section d'Etude de la Corrosion par gaz et Metaux Liquides, France). Bull. Inform. Sci. Tech. (Paris), No. 62, 43-55(June 1962). (In French)

The reaction of commercial Be in the form of tubes and discs with carbon dioxide at high temperatures and pressures was studied. The carbon dioxide was dehydrated and deoxygenated. The effects of humidity, presence of CO, pressure, and metal purity on the reaction were determined. The results obtained are shown in tabular form and compared with previous studies. They show that commercial Be reacts rapidly with humid CO_2, but that the reaction is much less rapid if the gas is dehydrated. The reaction of very pure Be, Be charged with oxide, and alloyed Be is discussed. (tr-auth)

Fabrication

Refer also to abstract 15522.

14776 (AD-285214) TUNGSTEN TO GRAPHITE BONDING. Final Technical Report. J. Ralph Armstrong and Roger A. Long (Narmco Research and Development, Div. of Telecomputing Corp., San Diego, Calif.). Sept. 30, 1962. Contract DA-04-495-ORD-3028. 21p.

Tungsten to graphite based bonds were evaluated as to tensile strength vs temperature and thermal shock resistance. Tensile strengths varied from 530 psi at RT to 193 psi at 4000°F. No thermal shock failures were observed under the test conditions, 3500°F in ten seconds to a maximum temperature of 4425°F, followed by cooling to below red heat in 15 seconds. (auth)

14777 (AD-297178) DEVELOPMENT OF FINE DIAMETER HIGH-PURITY WIRE FROM ZONE-REFINED BERYLLIUM. Final Report. Technical Report No. 298-236. A. G. Gross, Jr. and R. G. O'Rourke (Brush Beryllium Co., Cleveland). Dec. 1962. Contract NOw-62-0067-c. 60p.

Zone-refined crystals of both thermally and electrolytically reduced Be were converted to polycrystalline aggregates by a combination of deformation and heat treatment. The resulting polycrystalline aggregates were subjected to deformation at 450°C by standard Be wire-drawing techniques. A limited amount of metallurgical evaluation of the resulting wire was accomplished. It was found that combination of twinning and primary recrystallization was required to convert the single crystal to a truly polycrystalline aggregate. The wire produced from zone-refined beryllium exhibited usable structural tensile properties at room temperature. (auth)

14778 (ASD-TR-7-532a(IX)) MACHINING OF REFRACTORY MATERIALS. Phase II Technical Engineering Report, November 1, 1962–January 31, 1963. N. Zlatin, M. Field, and J. Gould (Metcut Research Associates Inc., Cincinnati). Feb. 1963. Contract AF33(600)-42349. 126p. (AD-296419)

Tests to determine the feasibility of high speed milling (edge trimming) are in progress. Preliminary test results indicate that high speed milling offers a better than average potential for success in edge trimming 6Al-4V titanium sheet and 15-7 Mo sheet in the 500 to 2500 feet/minute cutting speed range. Drilling tests have been made using the Tornetic drilling unit and a constant speed drill press on D6AC steel in the 54-58 R_c hardness range. Tapping test results on B-120VCA titanium at 400 BHN are presented comparing the Tornetic tapping data with conventional tapping. Machining test data are also presented on B-120 VCA titanium, TZM Molybdenum, Mo 0.5 Ti, and D-31 Niobium alloy. (auth)

14779 (BMI-X-203) PREPARATION OF CHROMIUM ALLOY SPECIMENS BY ARC-MELTING AND FABRICATION TECHNIQUES. E. L. Foster, Jr., D. P. Moak, and H. D. Hanes (Battelle Memorial Inst., Columbus, Ohio). June 6, 1962. Contract [W-7405-eng-92]. 19p.

Specimens of Cr–0.7 wt % Y alloy were prepared by conventional cold-mold consumable arc-melting followed by extrusion. The use of pre-alloyed powders in densification by gas-pressure bonding was examined. Both iodide and hydrogen-reduced electrolytic Cr were used in the extrusion studies which employed the Ugine-Sejournet process. Gas-pressure-bonding studies utilized only the H_2-reduced electrolytic Cr–0.7 wt % Y arc-melted alloy. It is believed that sound specimens were fabricated by both techniques, however, the evaluations and testing at LRL will be necessary to validate the results. (auth)

14780 (CEND-156) THE DEVELOPMENT AND TESTING OF UO_2 FUEL SYSTEMS FOR WATER REACTOR APPLICATIONS. Third Quarterly Report, January–March 1962. B. E. Murtha and W. P. Chernock (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). Apr. 1962. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT (30-1)-2863. 68p. (EURAEC-428)

Three methods of fabricating fused UO_2 powder type fuel elements are under development. The methods are: vibratory compaction, swaging, and Rock Riting. Preliminary densification during loading was adapted to all three fabrication techniques. Depending upon the intended final process, densities between 75 and 85% T. D. (theoretical density) are attained during this predensification cycle. Densities of 89 to 90% T. D. are attained by a final high impact vibratory compaction process and densities of 90 to 92% T. D. are attained by swaging. Density variations of about ±1.5% are found in the vibratory compaction specimens and about ±1% in the swaging specimens. Tools, jigs, and fixtures were developed for projection welding square and hexagonal fuel rod clusters. As many as nine fuel rods in a layer can be welded simultaneously to a 0.062 inch diameter spacer wire. Detailed parameters are being developed for use with Type-347 stainless steel tubes having a 0.020 inch wall thickness. High pressure collapse tests are being carried out to help define the mode of collapse of free standing tubing. The t/r (thickness/radius) ratios and pressures of greatest interest (0.8 to 1.2) were not adequately defined by the classic equations for elastic and inelastic collapse under external pressure. Collapse occurred at a pressure substantially below that predicted by either of the above theories. Studies of fuel supported tubing indicated that powder densities of about 85% T. D. are required to adequately support and maintain the shape of thin walled tubes. Helical springs and split sleeves were tested and found to be inadequate for support of 0.010 inch tube walls in the void region above the fuel. (auth)

14781 (GEAP-3997) EXAMINATION OF 304 STAINLESS STEEL CLADDING FROM COLD-SWAGED AND ROLLED FUEL RODS. W. V. Cummings, D. R. Lewis, and R. E. Blood (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). July 1962. Contract AT(04-3)-361. 47p.

Samples of 304 stainless steel cladding from unirradiated fuel rods fabricated by cold swaging and tandem rolling were investigated to determine the effects of cold working. These fabrication techniques were found to produce a structure containing a large amount of slip bands. Results of tensile tests and fracture behavior observations indicate that this cladding should be adequate for boiling reactor fuel rods. (J.R.D.)

14782 (HW-73759) SPECIFICATIONS—FLAT, NOTCHED TENSILE SPECIMENS. A. L. Bement (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 22, 1962. Contract AT(45-1)-1350. 4p.

A detailed specification of the requirements for machining flat, notched tensile specimens from type 348 stainless steel blanks of nominal dimensions $1 \times 0.050 \times 3\frac{1}{4}$ in. is presented. (H.G.G.)

14783 (HW-SA-2679) AN INCREMENTAL LOADING PROCESS TO CONTROL PLUTONIUM ENRICHMENT IN MECHANICALLY-MIXED OXIDE FUEL SYSTEMS. C. H. Bloomster, R. E. Bardsley, and W. T. Ross (General Elec-

tric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 1, 1962. Contract AT(45-1)-1350. 14p.

Data and information concerning the distribution of PuO_2 in UO_2 in mechanically mixed oxide fuel fabrications are presented. The areas of concern in control of Pu distribution include control of the absolute Pu content and control of the Pu longitudinal variation in each rod. Discussions are presented concerning vibratory and swage compaction processes in which incremental loading techniques were found to be effective. (J.R.D.)

14784 (HW-SA-2682) FABRICATION OF PLUTONIUM-BEARING CERAMIC FUEL ELEMENTS BY VIBRATIONAL COMPACTION. R. K. Koler and R. E. Sharp (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 9, 1962. Contract AT(45-1)-1350. 23p.

A fabrication process utilizing electromagnetic vibrational energy to compact loose physically mixed PuO_2-UO_2 powders clad with zircaloy was developed. After completing the initial tube preparation steps, the tube has the first end cap welded in place. The tube is then prepared for loading by attaching a disposable steel sleeve. The rods are loaded with 140 increments of both coarse and fine materials. When the tube is filled, a tamping rod is inserted in the tube end and the rod is vibrated between 215 and 3000 cps until no further settling of the powder takes place. The process is repeated until the desired core weight is obtained. After loading is completed, the rod is decontaminated and the cap welded on. After welding the rods are etched, autoclaved, and wrapped with zircaloy wires to provide spacing in the cluster. (M.C.G.)

14785 (HW-SA-2683) FABRICATION OF UO_2-PuO_2 SWAGE COMPACTED FUEL ELEMENTS. R. E. Bardsley and R. E. Sharp (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 1962. Contract AT(45-1)-1350. 25p.

A fuel element fabrication process involving swage compaction of loose, physically mixed PuO_2 and UO_2 powder clad with Zircaloy is described. A process flowsheet for production of swaged UO_2-PuO_2 clusters is included along with discussions of tube preparation and rod fabrication. (J.R.D.)

14786 (KR-33) BRAZING OF REACTOR COMPONENTS. G. I. Friedman (Norway. Institutt for Atomenergi, Kjeller). Dec. 1962. 21p.

Brazing is presented as a useful technique for reactor joining applications. A definition of the brazing process and a short discussion of the characteristics of an ideal brazing alloy are given. The alloys discussed include Ni-base high-strength, high-temperature alloys which offer excellent corrosion resistance in high-temperature water, but which possess low ductility and have a tendency to dissolve the base metal; Ag-base moderate-strength alloys, possessing poor corrosion resistance in high-temperature water, but which are ductile and flow readily; and Pd-base alloys which combine the strength and corrosion resistance of the Ni-base alloys with the ductility and non-erosive characteristics of the Ag base group. (auth)

14787 (NMI-1248) FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. CONCEPTUAL DESIGN OF U^{233} FUEL REFABRICATION PLANT. Summary Technical Report to the United States Atomic Energy Commission for the Period July 1, 1960 through June 30, 1961. W. B. Nowak and B. W. Wessling (Nuclear Metals, Inc., Concord, Mass.). July 30, 1962. Contract AT(30-1)-1565. 181p.

A preliminary study was made of a direct access, streamlined process for the rapid fabrication of (4 to 7)% UO_2-ThO_2 fuel using U^{233}. The fabrication of nuclear fuel elements containing U^{233} is complicated by the high alpha activity and very energetic gamma rays arising from the unavoidable presence of small quantities of U^{232}. Analysis of the fuel expected from the Consolidated Edison Indian Point Reactor indicated an average contamination of about 400 ppm U^{232} in U for material cycled three times and about 200 ppm for material cycled once. Feasibility for most of the major steps of a streamlined process was demonstrated experimentally. The process is: separation of U^{232} daughters by solvent extraction, coprecipitation of ADU and $Th(OH)_4$, filtration, calcination, reduction, and simultaneous ball-milling to produce powder, cold compaction of pellets, sintering of pellets, grinding, subassembly, and assembly of fuel element. The process is adaptable to fabrication by vibratory compaction or swaging. About 8 days are required to fabricate three complete fuel elements for the Consolidated Edison reactor. A detailed engineering evaluation of the process was made, a plant layout developed, and equipment specified. Calculated estimates of the radiation levels expected from contamination of glove boxes and equipment and from the fuel at various stages in this process indicate that only minimal shielding and inexpensive manual equipment is required, permitting direct, rather than remote, access to the fuel. (auth)

14788 (NMI-9700,6) DEVELOPMENT OF DIES FOR EXTRUSION OF COMPLEX SHAPES OF STEEL AND REFRACTORY ALLOYS. Interim Technical Documentary Progress Report to Aeronautical Systems Division for the Period September 16, 1962 through December 31, 1962. J. G. Hunt, R. G. Jenkins, A. M. White, and P. Loewenstein (Nuclear Metals, Inc., West Concord, Mass.). Mar. 4, 1963. Contract AF33(657)-8798. 23p.

A number of ceramics, metallic compounds, and ceramic-metal composites were successfully hot pressed into the shape of die inserts. Steels were extruded through several of these for the purpose of evaluating the materials or to study methods of supporting the die inserts. Refractory metal inserts were also used in similar tests. Hot pressed inserts consisting of 80 vol % Al_2O_3-10 vol % W and 80 vol % ThO_2-10 vol % W cracked but did not erode. Sintered molybdenum inserts flowed excessively, whereas sintered tungsten inserts flowed to a lesser degree. A hard die casing with a slight shrink fit appears to be the most satisfactory method of support. (auth)

14789 (NYO-10456) ULTRASONIC WELDCLADDING OF FLAT-PLATE FUEL ELEMENTS. (Aeroprojects, Inc., West Chester, Penna.). June 1962. Contract AT(30-1)-1836. 113p.

Techniques and equipment were developed for ultrasonic bonding of 0.010- and 0.020-inch X8001 aluminum alloy cladding to cores of depleted 20 and 27.5 wt % U_3O_8 dispersed in aluminum. Core faces were clad by overlapping seam welds using roller-type welding equipment. Best results were obtained using a cladding of X8001 that had been preclad on one side with 1100 aluminum. Blister formation in the cladding bonds at elevated temperatures was eliminated by washing in acetone and baking for ½ hour at 300°F prior to welding to remove all moisture and volatile material. The use of a 5-Kw roller welder with a disk tip revealed limitations in disk tips for high-power applications. A 2-Kw welder with a roller hoop configuration attached to an inverted exponential mechanical transformer accomplished face cladding at a rate of ~20 $in.^2$/min. The ultra-

sonic weld-cladding process has a feasible potential for cladding materials other than aluminum. (H.G.G.)

14790 (ORNL-TM-446) A TECHNIQUE FOR THE QUANTITATIVE CHARACTERIZATION OF DISPERSIONS. J. H. Cherubini and Sigfred Peterson (Oak Ridge National Lab., Tenn.). Feb. 28, 1963. Contract W-7405-eng-26. 25p.

Degradation of fuel particles encountered during the production of any metal matrix dispersion fuel is a recurring problem. During the development of dispersion fuel plates of UO_2 in stainless steel, it has been observed that changes in the fabrication process profoundly affect the quality of the dispersion. Two types of defects observed are fragmentation, in which the original particles are fractured and the ensuing fragments are distributed discretely in the matrix, and stringering, in which the original particles remain identifiable as an entity but are extended either plastically or by fracture. A method was developed to quantitatively index the quality of dispersions, measuring the deviation due to both types of defects from a hypothetical ideal model in which the particles are represented by intact, randomly distributed spheres. The indexing method is demonstrated on a variety of dispersions of spherical UO_2 in stainless steel and found to reliably and reproducibly assess the quality of dispersions. (auth)

14791 (TID-16307) SURFACE TREATMENTS FOR DIFFICULT TO BOND PLASTIC MATERIALS. N. J. De Lollis and O. Montoya (Sandia Corp., Albuquerque, N. Mex.). [July 1962]. Contract AT(29-1)-789. 15p. (SCDC-2721)

A number of synthetic resin materials have been developed which are noted for excellent electrical properties and for being inert to most environments. However, these materials are difficult to bond with conventional adhesives. These materials are polytetrafluoroethylene (Teflon), polychlorotrifluoroethylene (Kel-F), polypropylene, and polyethylene. Treating solutions make it possible to increase the area of application for these materials so that past limitations on use of these materials no longer apply. (auth)

14792 (TID-17930) CYCLIC PRESSURE TESTS OF LARGE SIZE PRESSURE VESSELS. Progress Report No. 1, October 15, 1962 to January 15, 1963. A. G. Pickett and J. D. Michie (Southwest Research Inst., San Antonio). Jan. 15, 1963. Contract AT(11-1)-1228. 51p.

Activities in a program to study the effects of welding defects on low-cycle fatigue of pressure vessels are reported. The vessels under study have 36-in. ID and 2-in. wall thicknesses, and contain nozzles of various designs and sizes. A cylindrical portion of vessel #4 was removed by flame cutting and replaced by welding; cyclic testing is to be resumed on this vessel to obtain data on the behavior of the weld repairs. Test vessel #5 ruptured unexpectedly after 3, 603 cycles. Results of a detailed examination of vessel material, fabrication procedures, testing procedures, fracture mechanics, and failure analysis of vessel #5 are presented. Committee agreements on further investigation are discussed. Data and information are included on properties and procedures for welding T-1 steel for vessel #5. (J.R.D.)

14793 (UCRL-6932) ISOSTATIC COMPACTION OF PARTICULATE PURE METALS WITHOUT CONTAMINATION. R. F. Bunshah and R. S. Juntz (California. Univ., Livermore. Lawrence Radiation Lab.). Jan. 28, 1963. Contract W-7405-eng-48. 16p.

A method for compacting particulate metals of various shapes and sizes into electrodes is described. It consists of isostatic compaction of the material in an elastomeric bag with a flexible stainless steel liner between the bag and the material. The stainless liner is included in order to prevent inclusion of the bag material in the compact and consequent contamination of the compact. (auth)

14794 FABRICATION OF BERYLLIUM BY FUSION, SPINNING, AND ROLLING. Ch. Sauve. Bull. Inform. Sci. Tech. (Paris), No. 62, 20-8(June 1962). (In French)

The methods for the recovery of Be from its ores, preparation of crude Be, its purification, and fabrication are described. The mechanical properties of Be are briefly reviewed. (J.S.R.)

14795 PRODUCTION OF HIGH-PURITY BERYLLIUM BY ELECTROREFINING IN FUSED SALT BATH. G. Boisde, M. Broc, G. Chauvin, H. Coriou, L. Hardy, and P. Jarny (Section d'Etude de la Corrosion Aqueuse et d'Electrochimie, France). Bull. Inform. Sci. Tech. (Paris), No. 62, 29-38(June 1962). (In French)

The technique used for the electrorefining of Be in fused salt bath is described. The phenomenon of impurity concentration in the vicinity of the cathode is discussed, and the effect of granulometry on the purity of the refined metal is considered. In conclusion, the mechanism of electrorefining is described. (J.S.R.)

14796 WELDING ALUMINUM FOR THE NUCLEAR POWER INDUSTRY. W. J. Burns (Canadian General Electric Co., Peterboro, Ont.). Can. Welder, 52: 13-15(Oct. 1961).

The welding of the calandria for Canada's NPD-2 reactor is discussed. The calandria is held together with about 4 miles of weld passes and when fully loaded it weighs some 200 tons. Two welding processes were chosen, metallic inert gas and tungsten inert gas. Equipment and methods are described. (M.C.G.)

14797 WELDING OF ZIRCONIUM. Tatsuya Hashimoto (National Research Inst. for Metals, Japan). Nippon Genshiryoku Gakkaishi, 5: 60-9(Jan. 1963). (In Japanese)

The most important problem in welding of zirconium is inert gas shielding. The weld is often contaminated by atmosphere during the welding. But a proper shielding can prevent the weld from embrittlement and deterioration of corrosion resistance of weld caused by atmospheric contamination. The best way of shielding is to use the inert gas or vacuum chamber. But with an improved shielding method, even in atmospheric environment, satisfactory welds can be obtained. Generally, zirconium alloy has excellent weldability and is practically ductile and corrosion-resistant welds can be easily obtained without porosity or cracks. (auth)

14798 DEFORMATION TEXTURES IN ROLLED NIOBIUM. D. I. Lainer, V. Ya. Solov'ev, E. I. Krupnikova-Perlina, and E. V. Kachur. Tsvetn. Metal., No. 11, 80-5 (Nov. 1962). (In Russian)

Preliminary technological treatment did not affect the deformation texture, but a final rolling gave some improvement. Admixtures of O, N, and C did not interfere with the fine rolling structure. The deformation axes in rolled Nb are (112) [110] + (100) [110]. (R.V.J.)

14799 PROTECTION OF CERAMIC REACTOR FUEL DURING WELDING. H. Chapman (Canadian General Electric Co., Ltd., Peterborough, Ont.). Welding J. (N. Y.), 42: 201-6(Mar. 1963).

The special steps taken to protect the UO_2 pellets during the welding of end caps to the Zircaloy sheath in the fabri-

cation of NPD fuel are described. Breakage of the pellets is reduced by use of higher currents for faster welding and use of a copper collet around the sheath near the weld. (D.L.C.)

14800 REPORT OF THE UNITED STATES WELDING DELEGATION ON VISIT TO THE SOVIET UNION, JULY, 1962. (E13-62). New York, American Welding Society, 1962. 70p. $1.50.

The visit of 5 members of the American Welding Society to the Soviet Union on July 3 to 17, 1962, is described. (M.C.G.)

Properties and Structure

14801 (AD-278452) THERMOELECTRIC MATERIALS. Bi-Monthly Progress Report No. 12, November 1 to December 31, 1961. (Titanium Alloy Mfg. Div., National Lead Co., Niagara Falls, N. Y.). Jan. 15, 1962. Contract NObs 78326. 14p.

Standard ceramic bodies of UO_2 additions to CeO_2 were formed; Standard ceramic bodies of $YCrO_3$ with standard series addition of TiO_2 CeO_2, ZrO_2 were fabricated and their pertinent ceramic properties tabulated. Standard ceramic bodies with additions of SnO_2 to $YCrO_3$ were formed as well as those of $LaCrO_3$ with additions of TiO_2, CrO_2, ZrO_2, and SnO_2. Temperature, Seebeck coefficient, and resistivity values are tabulated for 47 compositions. $PbNb_2O_6$ with 0.5 mole % Bi_2O_3 had the largest negative Seebeck coefficient, of moderate consistency with temperature, of any material thus far measured. Following this and of the same general characteristic are: $PbNb_2O_6$ plus 0.1 mole/% Sb_2O_5; $PbNb_2O_6$ plus 5.0 mole/% CdO; and $Pb_2Nb_2O_7$ plus 5.0 mole/% CdO. (auth)

14802 (AD-278727) DESIGN DATA STUDY FOR COATED COLUMBIUM ALLOYS. Bimonthly Report No. 3, April 21–June 21, 1962. J. D. Gadd (TAPCO. Div. of Thompson Ramo Wooldridge Inc., Cleveland). July 21, 1962. Contract NOw-62-0098-c. 26p. (TM-3470-67)

Final evaluation of the screening tests on seven oxidation protective coatings applied to D-14 alloy has been completed. Coatings applied by Pfaudler, TRW, and Vought have been tentatively selected for evaluation in the design data study, and the GT&E coating was selected as an alternate. Fansteel 85 alloy will be the base material for the design data study. A brief evaluation of the three candidate coatings applied to FS-85 alloy was performed, involving room temperature bend tests, cyclic oxidation tests at 2000 and 2600°F and room temperature prestrain followed by cyclic oxidation at 2000 and 2600°F. Specimen preparation is in progress for the design data study and a description is presented of the specimen design and testing equipment for this phase of the program. (auth)

14803 (AERE-M-1114) THE VARIATION WITH CARBON CONTENT OF THE LATTICE PARAMETER OF THORIUM MONOCARBIDE. R. S. Street and T. N. Waters (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). 1962. 5p.

Samples of ThC_x made and annealed at 1600 ± 100°C had the cubic, NaCl, structure with the cell-edge varying from 5.296 ± 0.004 to 5.335 ± 0.004 Å. The approximate range of composition of the phase was $ThC_{0.65}$ to $ThC_{0.95}$. (auth)

14804 (AERE-M-1115) THE THERMAL EXPANSION OF ThC AND ThN. R. S. Street and T. N. Waters (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Oct. 1962. 5p.

The cubic lattice parameters of ThC and ThN were measured from room temperature to 900°C. The average linear thermal expansion coefficients were found to be: ThC – $(6.53 \pm 0.071) \times 10^{-6}$/°C, ThN – $(7.39 \pm 0.042) \times 10^{-6}$/°C. (auth)

14805 (ARF-2158-12) DEVELOPMENT AND EVALUATION OF HIGH-TEMPERATURE TUNGSTEN ALLOYS. Summary Report. F. C. Holtz and R. J. Van Thyne (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Nov. 12, 1959. Contract AT(33-3)-4. 67p. (LAR-19)

Tungsten-rich alloys, developed for use at temperatures up to 2000°F, exhibit ductility, fabricability and joinability not found in commercially-available materials. An envelope type of microstructure was produced in compositions containing at least 90 wt % tungsten by liquid-phase sintering of cold-pressed powders in hydrogen. At room temperature the alloys could be rolled extensively, and tensile elongations up to 25% were noted. Strength properties of a W–Ni–Fe base were improved by small quaternary additions. The ultimate tensile strength of a 90W-4.8Ni-3.2Fe-2Ru alloy was 46,700 psi at 2000°F, compared to 30,000–35,000 psi for unalloyed tungsten or W–Ni–Fe; the 100-hour stress-rupture strength at 1600°F was 15,000 psi. Excellent joints were produced by spot welding and localized induction heating. The oxidation resistance of unprotected 90 wt % tungsten compositions was not significantly affected by alloying. (auth)

14806 (ARF-2158-18) DEVELOPMENT AND EVALUATION OF HIGH-TEMPERATURE TUNGSTEN ALLOYS. Quarterly Report No. 2, January 1, 1960–March 31, 1960. F. C. Holtz and R. J. Van Thyne (Illinois Inst. of Tech., Chicago. Armour Research Foundation). June 24, 1960. Contract AT(33-3)-4. 16p. (LAR-44)

Room-temperature properties were determined for W–Ni–Fe–Ru base alloys containing Cr, Mo, Pd, and Ta; highest strength levels were found in W–Ni–Fe–Ru–Mo compositions. Annealing for 250 hours at 1600°F produced a precipitate in the matrix phase and increased hardness in some of the tungsten-base alloys under study. Oxidation tests at temperatures up to 2000°F showed that additions of Al, Cr, Mo, Pd, and Ti improved the oxidation resistance of the W–Ni–Fe base. A fused coating of AMS 4775 protected a 90W-6Ni-4Fe alloy for 72 hours in air at 2100°F. (auth)

14807 (ARF-2158-21) DEVELOPMENT AND EVALUATION OF HIGH-TEMPERATURE TUNGSTEN ALLOYS. Quarterly Report No. 3, Apr. 1, 1960–June 30, 1960. F. C. Holtz and R. J. Van Thyne (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Aug. 10, 1960. Contract AT(33-3)-4. 20p. (LAR-45)

High-tungsten alloys were prepared by powder metallurgy techniques. Excellent strength and ductility at room temperature were found in the W–Ni–Mo–Ru system and in W–Ni–Fe alloys containing platinum and/or ruthenium. The effects of prolonged annealing at 1600°F on room-temperature properties were studied; W–Ni–Fe–Pt–Ru alloys were least affected by this treatment. Oxidation rates for most alloys at 2000°F were 2 to 4 times that of unalloyed tungsten; an exception was a W–Ni–Mo–Ru alloy which oxidized at $\frac{1}{5}$ the rate of tungsten. Slip casting techniques and induction-sintering of loosely compacted powders were used to produce compacts of W–Ni–

Fe materials having section thicknesses of 1 to 2 inches. (auth)

14808 (ARF-2158-24) DEVELOPMENT AND EVALUATION OF HIGH-TEMPERATURE TUNGSTEN ALLOYS. Final Report, October 1, 1959–September 30, 1960. F. C. Holtz and R. J. Van Thyne (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Dec. 14, 1960. Contract AT(33-3)-4. 57p. (LAR-46).

Ductile high-tungsten alloys, prepared by liquid-phase sintering techniques, were developed for temperatures up to 2000°F. Several alloy systems based on W–Ni–Ru with additions of Fe, Mo, or Pt had excellent ductility and useful high-temperature properties; tungsten levels were maintained at 90 wt%, and the ruthenium and platinum additions ranged from 0.5 to 1 wt%. Room-temperature tensile strength values were in the 130,000 to 160,000 psi range with 15 to 25 per cent elongation; ultimate tensile strength values ranged from 34,000 to 41,000 psi at 2000°F; and oxidation rates of 0.0015 to 0.034 inch per hour were measured at 2000°F. The long-time rupture properties at 2000°F were not substantially improved by small alloying additions to the W–Ni–Fe system. Fused coatings of a nickel-chromium base alloy, AMS 4775, gave excellent protection to W–Ni–Fe alloys for 500 hours in air at 2000°F. Slip casting in plaster molds was used to produce fully dense sintered compacts of 95W–3Ni–2Fe up to $1\frac{1}{4}$ inches thick. Strong, ductile joints in sintered W–Ni–Fe composites were accomplished using localized induction heating, tungsten-electrode inert-gas welding, and oxyhydrogen torch welding. (auth)

14809 (ARF-B231-8) PILOT EVALUATION OF VANADIUM ALLOYS. Bimonthly Report No. 8, November 18, 1962–January 17, 1963. F. C. Holtz (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Feb. 11, 1963. Contract NOw 62-0101-c. 18p. (AD-296759)

Experimental vanadium-niobium base alloys were fabricated to sheet from 200-gram arc-melted ingots. The composition V–60 wt % Nb–1 wt % Zr–0.075 wt % C had ultimate tensile strength values of 97,000, 77,000, and 20,000 psi at 1800, 2000, and 2400°F, respectively. On a density-corrected basis, the values up to 2000°F were the highest of all materials studied under this and the preceding programs. The V–40 wt % Nb–30 wt % Ta–1 wt % Hf alloy had higher 2400°F strength (25,400 psi) but lacked the high room-temperature ductility of the V–Nb–Zr–C material. Extruded and wrought plate, and sheet stock from the second 100-pound ingot (nominal composition V–4 wt % Ti–20 wt % Nb–1 wt % Zr–0.075 wt % C) was received and distributed to organizations participating in the data-exchange program. A total of 44 pounds of usable material was obtained, compared to about 30 pounds for the first large ingot. (auth)

14810 (ARF-B6005-2) RESEARCH DESIGNED TO EVALUATE Zr–2.5Nb AND Zr–2.5Nb–0.5Cu ALLOYS FOR DELAYED FAILURE HYDRIDE SUSCEPTIBILITY. Quarterly Report No. 1, October 15, 1962–January 14, 1963. D. Weinstein and F. C. Holtz (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Jan. 21, 1963. Contract AT(11-1)-578. 9p.

The purpose of this program is to determine the extent to which Zr-2.5Nb and Zr-2.5Nb–0.5Cu exhibit delayed failure (static fatigue) under various conditions of hydrogen content, heat treatment, and ambient temperature. Specimens are hydrogenated to 200 ppm or 500 ppm by means of a modified Sieverts apparatus, heat treated or cold reduced, and then evaluated in dynamic tensile and delayed failure tests under a certain set of conditions. At the present time, data are insufficient to form any conclusions regarding static fatigue behavior of these alloys. (auth)

14811 (ASD-TDR-61-529) DETERMINATION OF THE EFFECTS OF ELEVATED TEMPERATURE MATERIALS PROPERTIES OF SEVERAL HIGH TEMPERATURE ALLOYS. M. M. Lemcoe and Alex Trevino, Jr. (Southwest Research Inst., San Antonio). Oct. 1961. Contract AF33 (616)-7056. 398p. (AD-283594)

The mechanical properties of five high performance alloys at room and elevated temperatures were determined. The five materials studied were 301 extra hard stainless steel; Ph15-Mo (Th 1050); AM 355); René 41; and N-155. The effects of temperature (up to 1900°F) and exposure (up to 1000 hours) at temperature on the tensile, compressive, bearing, and shear properties from measured stress-strain information in both the elastic and plastic range for the five materials are presented. The strength properties of the five materials decreased with increasing temperature over the range investigated at the lower exposure times of five and 10 hours. However, PH15-7Mo and AM 355 showed substantial increases in strengths after exposure for 100 and 1000 hours at 800°F, and smaller increases at 600°F. But at the higher test temperatures for each particular alloy, all five showed a decrease in strength with increasing exposure times. Of the five materials, N-155 generally showed the most gradual decrease in strength properties with increasing temperature. The 301 stainless steel exhibited the most significant change in strength properties, when testing temperature was increased from 800° to 1000°F; its tensile strengths decreased from about 80 percent of room temperature values at 800° to around 33 percent at 1000°F. (auth)

14812 (ASD-TDR-62-181) INVESTIGATION OF THE EFFECT OF ULTRA-RAPID QUENCHING ON METALLIC SYSTEMS, INCLUDING BERYLLIUM ALLOYS. Final Report, February 1, 1961–December 31, 1961. Charles B. Jordan (Electro-Optical Systems, Inc., Pasadena, Calif.). Dec. 30, 1961. Contract AF33(616)-8011. 38p. (AD-284409)

The effect of ultra-rapid quenching on Be–H, Be–O, Be–Al, Be–Si, Be–Sc, Be–Ni, Be–Cu, and Be–Zn alloys was investigated. In Be–H, Be–O, Be–Sc, and Be–Zn alloys, attempts to carry out the necessary experiments were unsuccessful because of difficulties as to material or technique which could not be overcome within the scope of the contract. In the other four systems, the best experimental results obtainable indicate that no significant change of structure is produced by rapid quenching. (auth)

14813 (BM-RI-6180) THERMAL EXPANSION OF THE OXIDES OF YTTRIUM, CERIUM, SAMARIUM, EUROPIUM, AND DYSPROSIUM. Roy L. Wilfong, Louis P. Domingues, LeRoy R. Furlong, and Joseph A. Finlayson (Bureau of Mines. College Park Metallurgy Research Center, Md.). July 1962. 26p.

The linear expansion of high-purity oxides of yttrium, cerium, samarium, europium, and dysprosium was determined by the interferometric method for the temperature range 25 to 1,000°C. Single-crystal magnesium oxide and single-crystal aluminum oxide were used as reference materials. The bulk density and crystal form of the nonreference materials also were determined. The coefficients of linear expansion in the range 25 to 1,000°C were found to be 8.10×10^{-6} for yttria, 12.10×10^{-6} for ceria,

10.81×10^{-6} for samaria (monoclinic), 10.35×10^{-6} for europia (monoclinic), and 8.13×10^{-6} for dysprosia, each given in centimeters per centimeter per degree Centigrade. A detailed investigation of the interferometric technique for measuring thermal expansion in this temperature range was made. The interferometer was found to be a precise tool but only when adequate precautions were taken. These precautions are described. (auth)

14814 (BMI-1616) INVESTIGATION OF THE YIELD PHENOMENON IN ZIRCALOY-2 AT ELEVATED TEMPERATURES. Frederic R. Shober, Ralph W. Getz, Paul B. Shumaker, Arthur P. Young, Maurice F. Amateau, and Ronald F. Dickerson (Battelle Memorial Inst., Columbus, Ohio). Feb. 14, 1963. Contract W-7405-eng-92. 40p.

The yield phenomenon in Zircaloy-2 was studied using high-temperature short-time tensile tests, internal friction measurements, and electron microscopy. The phenomenon exists at temperatures from 450 to 750°F. The effects of heat treatment, hydrogen content, loading rate, and grain size on the yield points are discussed. Methods were developed for preparation of thin foil sections of zirconium and Zircaloy-2 for electron transmission studies. Dislocations were observed in annealed zirconium. Internal-friction measurements indicated a temperature dependency of the internal-friction decay with time corresponding to the presence of a yield point, but did not identify a mechanism. Failure of specimen and capsule components which occurred during irradiation prevented the obtaining of creep data for Zircaloy-2 at 650°F. (auth)

14815 (BMI-X-10031) FISSION-PRODUCT RELEASE FROM FUEL-ELEMENT CLADDINGS. Quarterly Progress Report for October–December 1962. Fitz R. Winslow, Thomas S. Elleman, George G. Cocks, Josef Bugl, and Arthur A. Bauer (Battelle Memorial Inst., Columbus, Ohio). Jan. 1, 1963. Work performed under United States–Euratom Joint Research and Development Program. Contract W-7405-eng-92. 5p. (EURAEC-544)

Out-of-pile experiments to study Xe^{133} release from 2-mil foils of an iron-20 wt% chromium alloy impregnated with fission recoils were performed at 1000 and 1200°C. At increased temperature a rapid Xe^{133} release occurred over a period of 2 hr or less followed by a much slower release. Results indicated that for long times of heating, release continues at a low level which is proportional to the square root of time. The initial rate of release was concentration dependent; if apparent diffusion coefficients were calculated from the initial release data, they could be expressed as $D = (6 \times 10^3/c^{0.435}) \exp(-36{,}000/RT)$, where c is the concentration in fission-recoil atoms per cm^3. Concentration-dependent release behavior for Xe^{133} also was observed during studies in which the temperature of recoil-impregnated specimens was gradually and continuously increased. Evidence of bubble formation was obtained by electron-transmission studies. (auth)

14816 (CEA-2186) CONTRIBUTION A L'ETUDE DE LA TRANSFORMATION $\beta \rightarrow \alpha$ DANS L'URANIUM ET SES ALLIAGES. (Contribution to the Study of the $\beta \rightarrow \alpha$ Transformation in Uranium and its Alloys). Henri Aubert (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1962. 62p. Thesis submitted to Université, Paris.

The kinetics of the transformation of uranium alloys containing 0.5, 0.75, 1.0, 1.5, and 3 atom per cent Cr were studied. The influence of heat treatment before decomposition is discussed. The study of the transformation characteristics such as kinetics, residual phases, phenomena connected with the coherence between phases, reversibility below the equilibrium temperature, shows the following mechanisms exhibited during the decomposition of the β phase on lowering the temperature: 1) eutectoid, 2) bainitic, 3) martensitic. The study of the TTT diagrams of alloys containing decreasing percentages of chromium indicates that the unalloyed uranium transforms without maintaining the coherence above 600°C, where as at lower temperatures the transformation is mainly martensitic. The various alloying elements can be characterized by their influence on the three TTT curves corresponding to the three possible transformation mechanisms. The ability of the uranium alloys to alpha grain refining during isothermal decomposition or ambient temperature quenching is directly connected with the characteristics of the TTT diagrams and especially to the mode of bainitic transformation. (auth)

14817 (CEND-172) THE DEVELOPMENT AND TESTING OF UO_2 FUEL SYSTEMS FOR WATER REACTOR APPLICATIONS. Progress Report, Period Ending December 31, 1962. B. E. Murtha and W. P. Chernock (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). Jan. 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(30-1)-2863. 74p. (EURAEC-583)

Extension of earlier work on 1-ft-long fuel lengths resulted in the achievement of densities above 90% TD on fuel lengths up to 3 ft long. Appreciable segregation of the −200 mesh fines was noted. Attempts to load and compact on a continuous basis were terminated because of persistent problems with binding of the compaction ram. Pneumatic compaction equipment capable of handling up to 61 tubes for simultaneous compaction was built. As many as 11 tubes were simultaneously compacted resulting in typical densities of about 84% TD. A cold water loop was assembled to perform pressure drop tests on the projection welded spacer wires and to determine the extent of flow-induced vibrations. Another apparatus is being assembled to determine the performance characteristics of projection welded clusters when subjected to severe differential thermal elongation. Destructive testing of the welds indicates good strength characteristics in tension, shear and torsion. Equipment was designed and is now being fabricated to study the performance of powder fuel elements with very high thermal gradients typical of reactor operating conditions. Samples of fused UO_2 from the Kerr-McGee and Norton companies are being evaluated for correlation between microstructure and evolution of gas at elevated temperatures. Minor phases are being studied by x-ray-diffractions and microscopy techniques. (auth)

14818 (DRI-2039) RESEARCH ON THE EFFECT OF SELECTED RARE-EARTH SCAVENGERS ON THE PROPERTIES OF TUNGSTEN AND MOLYBDENUM. Quarterly Progress Report No. 1, February 1 through April 30, 1962. C. Samuel Miller and Donald T. Klodt (Denver. Univ. Denver Research Inst.). May 1962. 13p. (N62-11513)

Activities in an investigation of a processing method for removal of interstitial O_2 and N_2 from W and Mo are reported. Efforts during the period were devoted to production and evaluation of Mo and Mo–Y alloys. (J.R.D.)

14819 (GEST-2009) THERMIONIC EMITTER MATERIAL PROPERTIES. Technical Summary Report, September 15, 1961 through September 15, 1962. L. N. Grossman, E. W. Hoyt, J. H. Ingold, A. I. Kaznoff, and M. J. Sanderson (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). Oct. 15, 1962. 208p.

The thermal, mechanical, chemical, and electrical

properties of uranium and thorium-bearing carbides and two rare earth hexaborides, EuB_6 and YB_6, have been studied to determine their applicability as fuel-emitter materials. The thermal shock resistance of uranium bearing carbides is inadequate to maintain the required fuel-emitter structural integrity. The thermal and electrical properties of carbide materials are superior to corresponding oxide materials and have significant uses in clad fuel-emitter concepts. The work functions of bulk carbides generally fall below that of tungsten. The work functions of rare earth hexaborides range from ~4.8 v for EuB_6 to ~2.2 v for YB_6. The vapor pressures of the rare earth borides indicate that an upper temperature of ~1400°C exists for any application involving prolonged time. Cesium compatibility tests indicate marked sensitivity of carbon-rich carbide materials to cesium attack in periods <500 hr. Boride materials appear resistant to cesium attack, which produced deterioration of the carbides. (H.G.G.)

14820 (IA-744) GRAIN REFINEMENT OF DILUTE URANIUM–CHROMIUM ALLOYS. P. Wynblatt and A. Bar-Or (Israel. Atomic Energy Commission, Rehovoth). Sept. 1962. 21p.

A study was made of the grain refinement of dilute uranium-alloys, with chromium contents of 0.3, 0.45, and 0.6 at. %, respectively. Samples of the various alloys were isothermally transformed from β to α in the temperature range 600 to 300°C. The transformation temperature that produced the finest grain increased with decreasing chromium content. The range of isothermal transformation temperatures and of chromium content yielding maximum grain refinement was determined. (auth)

14821 (IS-513) MAGNETICALLY DILUTE ALLOYS, RARE-EARTH METALS, AND SUPERCONDUCTIVITY. Sam Legvold (Iowa State Univ. of Science and Tech., Ames and Ames Lab., Ames, Iowa). [July 16, 1962]. Contract W-7405-eng-82. 13p.

A survey of information concerning the basic interactions which give rise to certain magnetic properties in dilute alloys such as Co in Pd is presented. Research on virtual d-states, superconductivity, ferromagnetism, and thermoelectric effects is reviewed. Sections are included on transition metal alloys and compounds and on rare earth metals and alloys. (J.R.D.)

14822 (LADC-5428) CONCERNING THE EVIDENCE FOR THE EXISTENCE OF THE HIGH-TEMPERATURE γ'-PHASE OF CERIUM. Karl A. Gschneidner, Jr. and James T. Waber (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract [W-7405-eng-36]. 21p.

Three experiments were carried out in an attempt to verify the existence of the γ'-Ce phase reported by Weiner and Raynor but no evidence was obtained for a new allotropic modification of cerium. Instead, the experimental data indicated that the γ' phase is a CeX compound having the NaCl, Bl type structure. The available data suggest that CeX is probably CeO containing small amounts of silicon and possibly boron in solid solution. (auth)

14823 (LADC-5575) SOME THEORETICAL ESTIMATES OF THE PHYSICAL PROPERTIES OF THE RARE EARTH METALS. James T. Waber (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract W-7405-eng-36. 12p.

Recent determinations of the non-relativistic Hartree atomic wave functions have permitted an estimate of the electronic configuration of the free lanthanide atoms that is more stable and have permitted theoretical estimates of physical quantities such as the spin-orbital splitting parameter, Slater F^3 integral, diamagnetic susceptibility, atomic scattering factor and L emission spectra. The equilibrium Wigner-Seitz radius ρ and the compressibilities χ were recalculated by the Fröhlich-Raimes method. This method was extended to obtain the deviations from Vegard's law for a number of cerium based alloys. (auth)

14824 (LADC-5615) INFLUENCE OF MAGNESIUM ON SOME OF THE PHYSICAL PROPERTIES OF CERIUM. Karl A. Gschneidner, Jr. (Illinois. Univ., Urbana and Los Alamos Scientific Lab., N. Mex.). [1962]. Contract [W-7405-eng-36]. 13p.

The lattice parameters and low-temperature thermal expansion behaviors of a number of cerium-rich alloys containing up to 13 at. % magnesium have been examined. The lattice parameter data indicate a maximum solid solubility of 5.9 at. % magnesium in γ-Ce, and a positive deviation from Vegard's law. The dilation data show that magnesium decreases the temperature of the γ-α electronic transformation in cerium at the rate of about 11°K per 1 at. % magnesium. These results are discussed in terms of recently published data relative to other cerium-rich alloy systems. (auth)

14825 (LAR-12) DEVELOPMENT AND EVALUATION OF HIGH-TEMPERATURE TUNGSTEN ALLOYS. Quarterly Report No. 1. F. C. Holtz and R. J. Van Thyne (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Jan. 15, 1959. Contract AT(33-3)-4. 17p. (ARF-2158-3)

Tungsten-rich alloys for use at temperatures up to 1090°C are under development. High-temperature alloys containing at least 90 wt % tungsten were prepared by powder metallurgy techniques. Complete densification was obtained in a 99 wt % W-0.6 wt % Ni-0.4 wt % Fe alloy sintered in hydrogen at 1560°C the material was machinable but not cold-workable. Additions of 2.5 wt % minium of Cr, Mo, Ti, and Zr were made to a 90 wt % W–Ni–Fe base. Chromoum and molybdenum increased the room-temperature strength without undue loss of ductility. Titanium and zirconium additions resulted in the presence of some unreduced oxides in the microstructures. Moderate workability and high room-temperature strength was found in a 90 wt % W-5 wt % Ni-5 wt % Cr composition. Elevated temperature testing of these materials is in progress. Processing techniques including hot-pressing and also sintering of uncompacted powders are under study to determine the feasibility of producing large parts of complex shapes. Protection from oxidation has been achieved by coatings which include a commercial nickel-chromium-base alloy and electrodeposited chromium; a weight gain of 0.07 mg/cm^2/hr was reported for a duplex coated specimen after 100 hours in air at 1090°C. (auth)

14826 (LAR-14) DEVELOPMENT AND EVALUATION OF HIGH-TEMPERATURE TUNGSTEN ALLOYS. Quarterly Report No. 2. F. C. Holtz and R. J. Van Thyne (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Apr. 17, 1959. Contract AT(33-3)-4. 15p. (ARF-2158-6)

High tungsten alloys for service up to 1090°C were prepared and tested. Compositions containing between 90 and 99.5 wt % tungsten were produced by powder metallurgy techniques. Ternary W–Ni–Fe alloys exhibited maximum room-temperature strength at 95 wt % tungsten, and tensile elongation values decreased above 90 wt % tungsten. At 1090°C the greatest strength occurred between 95 and 97 wt % tungsten; a 100-hour stress-rupture life was

estimated at 2500 to 3000 psi for compositions containing up to 99 wt % tungsten. Quaternary additions of Al, C, Cr, Mo, Th, Ti, V, and Zr to a 90W–Ni–Fe base were studied. Moderate improvements in elevated-temperature properties were effected by alloys containing 0.1 wt % carbon, 3 wt % chromium or 5 wt % molybdenum; and room-temperature workability was not seriously impaired. Other alloy systems investigated included 90W–Ni–Cr and 90W–Ni–Ru. Properties of the compositions containing chromium were similar to those of the W–Ni–Fe alloys; initial results for the W–Ni–Ru materials indicate a higher melting matrix phase which may improve the strength properties at 1090°C. (auth)

14827 (LAR-17) DEVELOPMENT AND EVALUATION OF HIGH-TEMPERATURE TUNGSTEN ALLOYS. Quarterly Report No. 3. F. C. Holtz and R. J. Van Thyne (Illinois Inst. of Tech., Chicago. Armour Research Foundation). July 15, 1959. Contract AT(33-3)-4. 23p. (ARF-2158-9)

High-tungsten alloys prepared by powder metallurgy techniques were evaluated at temperatures up to 2000°F (1090°C). Alloys of the W–Ni–Fe system containing 90 to 97 wt % tungsten were cold-workable and had ultimate tensile strength values up to 34,000 psi at 2000°F (1090°C). The effects of small quaternary additions of Al, C, Cr, Mo, Th, Ti, V, and Zr to the W–Ni–Fe base were studied. Alloys of the W–Ni–Co system containing 90 to 97 wt % tungsten exhibited reduced strength and ductility at room temperature but were considerably superior to W–Ni–Fe compositions at elevated temperatures. Quaternary additions of Cr, Fe, and Mo to the W–Ni–Co base were evaluated. Other alloy systems studied to a limited extent included W–Ni–Cr, W–Ni–Ru, W–Co–Ru, and W–Co–Cr; tungsten levels were maintained at a minimum of 90 wt %. Induction heating, spot welding, and tungsten inert-gas welding techniques were used to join pieces of sintered W–Ni–Fe alloys. Initial results showed that satisfactory bonds are obtained by heating the contact areas to a temperature slightly above the melting point of the matrix phase. Successful roll bonding of Nichrome to W–Ni–Fe specimens at 2200°F (1200°C) indicates the possibility of improved oxidation protection. (auth)

14828 (NAA-SR-Memo-7832) LOW PRESSURE CONTACT CARBURIZATION OF 304 STAINLESS STEEL AND GRAPHITE. S. K. Lee (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Oct. 19, 1962. Contract [AT(11-1)-Gen-8]. 9p.

The potential carburization of Type 304 stainless steel by graphite under conditions found in the calandria core of ASCR was investigated. Tests performed at 1300°F in He atmosphere indicated no carburization occurred with contact pressures below 50 psi. Specimens were evaluated on the basis of metallographic examination, hardness tests, and chemical analyses. (auth)

14829 (NAA-SR-Memo-7871) Al–Ni DIFFUSION REACTIONS. O. O. Gamba (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Oct. 30, 1962. Contract [AT(11-1)-Gen-8]. 11p.

The fuel-to-clad bond on three Piqua fuel cylinders was metallographically inspected in the "as-fabricated" condition and after 1,000 and 2,000 hours of isothermal treatment at 750°F under 100 to 140 psig. The normal growth of the Al_3Ni and Al_3Ni_2 intermetallic regions resulting from the Al-Ni diffusion reaction can be observed on both the outside diameter and the inside diameter surfaces of the cylinders. A separation produced during the annealing between the fuel and the aluminum end-plug rings joining the outside diameter and inside diameter cladding at the top and bottom of the cylinders prevented further migration of aluminum through these annular interfaces. As a result of the progressing nickel diffusion, the intermetallics primarily formed suffer a transformation into lower aluminum concentration phases (Al-Ni and Al-Ni_3). The Al_3Ni phase previously adjacent to the separated aluminum is the first to undergo this change. (auth)

14830 (NCSC-2663-9) STUDY OF PHASE RELATIONSHIPS IN THE U–C–O SYSTEM. Second Annual Progress Report. Robert F. Stoops and John V. Hamme (North Carolina State Coll., Raleigh). Sept. 1962. Work performed under United States–Euratom Joint Research and Development Program. Contract AT(40-1)-2663. 30p.

An investigation to develop stable, high-thermal-conductivity, ceramic fuels with more fissionable atoms per unit volume than are in UO_2 is reported. Phase studies are in progress on the U–C–O system. Significant results of this investigation include the fact that UO is not a stable phase at 1800°C or below. Oxygen is relatively insoluble in UO and may be completely insoluble within detectable limits. The lattice parameter of UO appears to be 4.965 ± 0.001 Å. Phases having the same crystal structure as UO were obtained with lattice parameters varying over a wide range. Specific values for the lattice parameters which occurred with a much greater frequency than average are 4.960, 4.950, and 4.92 Å. Materials with these lattice parameters are thought to have definite combinations of elements and to be more stable than materials with intermediate lattice parameters. A major portion of the experimental work involved efforts to determine the specific compositions of these phases and to develop reliable methods for producing them. The phase with 4.92 Å lattice parameter is probably UCN which has been mistakenly reported as UO in the literature. (J.R.D.)

14831 (NMI-2111) FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report to United States Atomic Energy Commission. October 1962. (Nuclear Metals, Inc., Concord, Mass.). Jan. 7, 1963. Contract AT(30-1)-2784. 16p.

Work continued on the preparation and evaluation of zone-refined Be crystals, and neutron-diffractometer rocking curve measurements are reported for the structure of two zone-refined Be crystals. The extrusion, hardness measurements at temperatures up to 1200°C, and oxidation measurements at 1000°C are reported for a large number of refractory metal alloys. Work on the development of U alloys strengthened by Slis techniques is continuing. (D.L.C.)

14832 (NMI-2800) STUDY OF THE BETA TREATMENT OF URANIUM. Progress Report to the Oak Ridge Operations Office for the Period November 1, 1959–April 1, 1960. R. B. Russell (Nuclear Metals, Inc., Concord, Mass.). Apr. 18, 1960. Contract AT(30-1)-1565. 18p.

Activities in a program to determine the effects of product size (or dimensions), composition, and heat treatment on beta-treated U are reported. Progress to date was chiefly confined to organizing the program and setting up equipment. A Jominy end-quench apparatus was constructed, and preliminary experiments were run on as-cast metal to test the Jominy-oscillograph-thermocouple system. Results are tabulated. The method to be used for characterization of beta-treated samples by

determination of growth index and texture is also described. (J.R.D.)

14833 (NMI-7016) DENT RESISTANCE OF ALUMINUM ALLOYS FOR HOUSING TUBES. Report to Savannah River Operations Office, United States Atomic Energy Commission. W. L. Larson (Nuclear Metals, Inc., West Concord, Mass.). Nov. 28, 1962. Contract [AT(30-1)-1565]. 29p.

Dent resistance was determined for a number of Al alloys to assist in the consideration of the possible replacement of the 6063 Al alloy presently used for housing tubes. For each alloy the dent depths are plotted against the impact loads with wall thickness as the parameter. Plots using other combinations of coordinates and parameters are also included. (auth)

14834 (NMI-9805) LITERATURE SURVEY OF GASES IN BERYLLIUM. Report to Wright Air Development Division. J. P. Pemsler and R. W. Anderson (Nuclear Metals, Inc., Concord, Mass.). Jan. 17, 1961. Contract AF33(616)-7665. 17p.

Structural and thermodynamic properties of beryllium, beryllium-oxygen systems, beryllium-nitrogen systems, and beryllium-hydrogen systems as determined by various researchers are surveyed. Diffusion properties, reaction kinetics, and vapor pressures are given where they were available. 44 references. (D.C.W.)

14835 (NP-12520) INFLUENCE OF TRANSFORMATION REACTIONS ON MECHANICAL PROPERTIES AND CORROSION BEHAVIOUR OF ZIRCONIUM–COPPER–MOLYBDENUM ALLOYS. C. F. Dixon (Canada. Dept. of Mines and Technical Surveys. Mines Branch). Jan. 23, 1962. 45p. (IR-62-3)

The transformation reaction for zirconium-copper-molybdenum alloys is shown to be: omega + beta → alpha prime → alpha + intermetallics. The influence of this reaction on room temperature mechanical properties, corrosion resistance, corrosion film and hydrogen pick-up was investigated. Results showed that during transformation considerable variation occurred in each of the above properties and these effects could be attributed to changes in phase structure that took place during the transformation reaction. (auth)

14836 (NP-12592) EXPERIMENTAL STUDY OF FACTORS CONTROLLING THE EFFECTIVENESS OF HIGH-TEMPERATURE PROTECTIVE COATINGS FOR TUNGSTEN. Quarterly Progress Report No. 2, August 15–November 15, 1962. M. G. Nicholas, C. D. Dickinson, and L. L. Seigle (General Telephone and Electronics Labs. Inc., Bayside, N. Y.). Dec. 15, 1962. Includes Appendix: COMPOSITIONAL AND STRUCTURAL STUDIES ON THE OXIDATION OF REFRACTORY COMPOUNDS AT HIGH TEMPERATURE. David I. Phalen, Dale A. Vaughan, Neil A. Richard, Alfred E. Austin, and Charles M. Schwartz (Battelle Memorial Inst., Columbus, Ohio). Contract AF33(657)-8787. 74p. (TR-62-461.7)

Two processes governing the efficiency of high-temperature protective coatings for tungsten, interdiffusion in ternary oxygen-metal-metal systems and breakaway during oxide film growth, are being investigated experimentally to determine the oxidation behavior of binary alloys and the influence of substrate mechanical properties on the growth characteristics of the oxide films. Experiments involving oxidation kinetics and the microstructural and quantitative identification of the layers formed have been conducted on four systems. An analysis of the diffusion processes governing growth in the Zr-Th-O system is presented, and a preliminary discussion of the results obtained in the W-Hf-O, ZrN-ThN-O, and Sn-Al-Cr systems is given. (auth)

14837 (NP-12595) OXIDATION RESISTANT HIGH TEMPERATURE PROTECTIVE COATINGS FOR TUNGSTEN. Quarterly Progress Report No. 7, November 1, 1962–January 31, 1963. (TAPCO. Div. of Thompson Ramo Wooldridge Inc., Cleveland). Feb. 15, 1963. Contract AF33(616)-8188. 54p. (TM-3612-67)

An improved and simplified coating process was developed to apply the Ti–Zr–(Si–W)–O complex coating to tungsten sheet. A series of W + Ti–Zr–(Si–W)–O coated systems were prepared and tested under cyclic conditions in air at temperatures of 1800, 2500, 3000, and 3450°F. Total exposures of 72 hours at 3000°F, 26 hours at 3300°F and 10 hours at 3450°F were achieved under cyclic conditions. Formation of an improved W + (Si–W) coated system was accomplished utilizing more efficient techniques for deposition of the (Si–W) coating layer on tungsten sheet. Cyclic oxidation tests of the W + (Si–W) system prepared by this technique were conducted in the 1800 to 3300°F temperature range. Additions of molybdenum were made to the W + Ti–Zr–(Si–W) and W + (Si–W) systems during the (Si–W) coating cycle using co-deposition techniques. These systems were subjected to cyclic oxidation tests at 1800, 2500, and 3000°F. Hot gas erosion tests were conducted on the W + Ti–Zr–(Si–W)–O and W + (Si–W)–O systems at 3500 and 3600°F. The maximum temperature capabilities of both coating systems under a high velocity flow of simulated air were determined. Thermal shock tests at 3000°F were conducted on preoxidized W + Ti–Zr–(Si–W)–O and W + (Si–W)–O coated systems. Results of the current tests indicate that the limiting factor in the protective life of coated tungsten is the sensitivity of the tungsten base metal to thermal shock cracking. (auth)

14838 (NRL-5880) CREEP-RUPTURE OF NICKEL OF TWO PURITIES IN CONTROLLED ENVIRONMENTS. P. Shahinian and M. R. Achter (Naval Research Lab., Washington, D. C.). Nov. 15, 1962. 13p.

In a comparison of the creep characteristics of nickel in a nitrogen atmosphere with those in a vacuum at 900 to 1500°F, it was found that the nitrogen atmosphere promotes intergranular cracking, increases creep rate, and reduces time to rupture. The effects are much greater for an impure (99.8 percent) than for a pure (99.99 percent) grade of nickel. In a similar manner, both air and a helium-oxygen mixture can decrease strength, but they may also, under conditions of temperature and strain rate conducive to oxidation, improve rupture time. To explain the effects of nitrogen on nickel, it is proposed that the gas interacts with grain boundary impurities and lowers the energy necessary for crack propagation. (auth)

14839 (NRL-5904) HIGH TEMPERATURE PROPERTIES OF SODIUM AND POTASSIUM. Progress Report No. 8, July 1 to September 30, 1962. T. A. Kovacina, C. T. Ewing, J. P. Stone, and R. R. Miller (Naval Research Lab., Washington, D. C.). Dec. 17, 1962. 5p.

A research program is in progress for the determination of various thermophysical properties of the alkali metals, sodium and potassium, at elevated temperatures. The status of each property test is discussed, and preliminary data are presented concerning the equilibrium solubility of Nb in liquid sodium in the temperature range 1479 to 2518°F. (auth)

14840 (NUMEC-P-46) HIGH-TEMPERATURE THERMAL CONDUCTIVITY OF URANIUM DIOXIDE. Richard A.

Wolf (Nuclear Materials and Equipment Corp., Apollo, Penna.). Sept. 4, 1962. Contract AT(30-1)-2389. 37p.

A theoretical investigation of the high-temperature thermal conductivity of UO_2 was conducted to find an explanation for earlier experimental data which indicate that conductivity in UO_2 increases with temperature above about 1500°C. It is felt improbable that radiation conductivity could be large enough to account for these results; free carrier conductivity might be. Further work upon which to base conclusions is suggested. (J.R.D.)

14841 (NYO-9458) EXPERIMENTAL DETERMINATION OF CONTACT CONDUCTANCE FOR SOME STAINLESS STEEL CONTACTS. Achilles Adamantiades (Massachusetts Inst. of Tech., Cambridge. Heat Transfer Lab.). July 1962. Contract AT(30-1)-2079. 32p.

Contact conductances for three semi-smooth and rough stainless steel contacts involving six steels are determined. The procedure and equipment used are fully described, and the results are given. Graphs display thermal conductance and conductivity versus pressure and temperature. (D.C.W.)

14842 (ORNL-3396) OUTGASSING CHARACTERISTICS OF VARIOUS GRAPHITES. L. G. Overholser and J. P. Blakely (Oak Ridge National Lab., Tenn.). Mar. 1, 1963. Contract W-7405-eng-26. 34p.

The outgassing characteristics of various graphites have been determined in vacuo to a maximum temperature of 1000°C using external resistance heating and to 1800°C by induction heating. The graphites examined include commercial and experimental lots of nuclear grades prepared from different sources of raw materials and subjected to varying manufacturing procedures. The ash content of the various grades ranges from ~5 to ~800 ppm and the calcium content from a few ppm to ~340 ppm. Representative data are presented which show marked differences in the composition of the desorbate and the fraction of the total evolved to various temperatures for different grades. The volume-time relationship is satisfactorily expressed as $v = A \log t + B$ for a number of the graphites over extended intervals of time. Marked deviations from this relationship at 600°C are reported for several grades of graphite characterized by a high calcium content. Variations in the CO_2/CO ratio in the desorbate at 600°C appear to be associated with these volume-time relationships observed at 600°C. Data are given which show the differences in the degassing behavior of a group of graphites having ash contents of <30 ppm. These data fail to show any significant effect of either the type of coke or the particle size distribution of the coke used as filler. It appears that the atmosphere present during letdown and the subsequent exposure prior to degassing are responsible for the differences noted. The degassing behavior of samples of graphite from the stock for use in the Experimental Gas-Cooled Reactor is described, including the release of sulfur compounds as a function of temperature and volume-time relationships at various temperatures. (auth)

14843 (ORNL-TM-460) A PRELIMINARY EXAMINATION OF THE FORMATION AND UTILIZATION OF TEXTURE AND ANISOTROPY IN ZIRCALOY-2. M. L. Picklesimer (Oak Ridge National Lab., Tenn.). Feb. 28, 1963. Contract W-7405-eng-26. 31p.

The anisotropy of mechanical properties in Zircaloy-2 associated with preferred orientation developed during manufacture has caused many difficulties in the fabrication and utilization of mill products. A preliminary examination of the development and utilization of texture preparatory to an experimental study of anisotropy in Zircaloy-2 tubing is presented. The development of preferred orientation during manufacture of Zircaloy-2 plate, strip, and tubing is qualitatively analyzed in terms of the plastic strain undergone, the modes of deformation operative, the existing anisotropy of flow strengths, and the effects of forming forces of the rolls or dies. The problem of forming structural shapes from anisotropic mill products is discussed, and the utilization of the anisotropy of mechanical properties to ease manufacture and to strengthen structures is considered. (auth)

14844 (SCNC-269) DIMENSIONALLY STABLE URANIUM ALLOYS. III. URANIUM–CARBON ALLOYS. I. Sheinhartz and J. L. Zambrow (Sylvania-Corning Nuclear Corp., Bayside, N. Y.). Feb. 1959. Contract AT(30-1)-Gen-366. 11p.

In an attempt to improve the strength at elevated temperatures of a 1.5% molybdenum in uranium alloy, a network of uranium carbide was incorporated within the structure of the alloy by use of powder-metallurgical techniques. Compositions containing up to 10% uranium carbide were evaluated by the use of hot hardness tests at temperatures up to 700°C. The additions of uranium carbide did not result in any apparent improvement in the hot hardness over the range of temperatures tested. (auth)

14845 (TID-15434) PERMEABILITY OF CLADDING MATERIALS TO INERT GASES. Final Report, November 15, 1960 through November 14, 1961. G. T. Murray, H. Kuzuu, H. Klints (Materials Research Corp., Orangeburg, N. Y.). Mar. 16, 1962. Contract AT(30-1)-2286. 47p. (MRC-287).

Helium was introduced into zirconium during neutron irradiation via transmutation of boron solute atoms. Specimens were subsequently heated at temperatures between 600 and 1400°C and the released gas analyzed on the mass spectrometer. For specimens heated below the alpha-beta transformation temperature, the computed diffusivities did not vary with temperature according to an Arrhenius relationship. Futhermore, restricted grain growth and microscopic evidence of "bubble" formation were obtained. In contrast, specimens heated above the transformation exhibited diffusivities that did vary with time and temperature in the expected fashion. The computed D vs T relationship obtained was $D = 2.0 \times 10^{-4} \exp(34{,}100/RT)$ $cm^2\ sec^{-1}$. Helium was introduced in aluminum in a similar manner by transmutation of lithium solute atoms. Subsequent heating and metallographic observations revealed that a fine bubble distribution was achieved by cold working the specimen prior to irradiation and heating. The bubbles then formed concomitant with recrystallization. Restricted grain growth by virtue of the presence of the bubbles resulted in a fine bubble network at the grain boundaries of the newly formed grains. Electron microscopy revealed that the bubbles formed in annealed aluminum were the order of 10^{-5} mm diameter. Mechanical tests did not show dislocation locking by helium atoms. (auth)

14846 (TID-16258) CUMULATIVE FATIGUE DAMAGE WITH PROGRESSIVE LOADING. R. R. Gatts (Knolls Atomic Power Lab., Schenectady, N. Y.). [1962]. Contract [W-31-109-eng-52]. 21p.

The advantages and limitations of the Prot or progressive loading fatigue test were examined in the light of a recently proposed concept of cumulative damage in fatigue of structural materials. The Prot method of evaluating the endurance limit is based on a fatigue test in which the

stress amplitude is increased linearly with cycles from an initial value below the endurance limit until failure occurs. The concept of cumulative damage is presented and compared with the Prot solution and available data. (M.C.G.)

14847 (TID-16526) POINT IMPERFECTIONS IN SODIUM METAL. Final Technical Report. Stefan Machlup (Western Reserve Univ., Cleveland). Aug. 1, 1962. Contract AT(11-1)-493. 31p.

Determination of the relative merits of the lattice vacancies and interstitial atoms as possible mechanisms for self-diffusion in Na by calculating the energy of formation of each of these defects and its change with pressure is discussed. The energy difference between a perfect lattice and a lattice with one point imperfection is determined. This energy difference is a combination of that due to the change in volume of the electron gas in defect formation and the energy of interaction of the electron charge with the defect. For both of these energies, the ion lattice is replaced by an immobile, uniform distribution of positive charge, into which is placed a single sodium ion (interstitial) or a single "anti-sodium ion" (vacancy). The electrostatic potential of the lattice at the position of the defect is calculated. (H.G.G.)

14848 (TID-17893) ANNEALING OF COLD WORKED METALS. Progress Report No. 11. P. A. Beck, B. G. Ricketts, R. W. Balluffi, D. R. Frankl, J. J. Gautier, L. C. Michels, W. T. Becker, W. Shieh, and D. N. Seidman (Illinois. Univ., Urbana). Dec. 31, 1962. Contract AT(11-1)-1124. 4p.

Results of annealing cold worked Al indicate that textures produced are dependent on the extent of cold work and on the last annealing temperature. Results of electron transmission microscopy studies of structural changes which occur during annealing of cold worked Al, Cu, and Ni are discussed. Nucleation was found to occur when recrystallization takes place in the thicker regions of the specimens which are not readily penetrated by the electron beam. The effects of thickness appear to be drastic. Further study is planned in the areas of recovery and recrystallization in bulk material. (J.R.D.)

14849 (TID-18051) DENDRITE GROWTH IN SUPERCOOLED METALS. Annual Report. Wylie J. Childs (Rensselaer Polytechnic Inst., Troy, N. Y.). Feb. 1963. Contract AT(30-1)-3004. 16p.

Measurements are made of the supercooling effects on dendrite growth velocity in pure bismuth. The shape of the dendrites as a function of the amount of supercooling using a vacuum decanting technique is discussed. The shape of the dendrites change markedly with supercooling. This change proceeds with increased supercooling from heavy hopper shaped crystals to the final form of dendritic loce, and individual transitions are overlapping in nature as the amount of supercooling increases. Most of the specimens, which were self nucleated at a supercooling greater than 60°C, exhibited a "sunburst" pattern at the crucible wall. High speed photography indicated that the origin of the sunburst is the point of initial nucleation. (H.G.G.)

14850 (TRG-Report-359) THE CRYSTAL STRUCTURE OF ALPHA URANIUM, AND TABLES OF CRYSTALLOGRAPHIC FUNCTIONS. D. E. Connolly (United Kingdom Atomic Energy Authority Reactor Group, Springfields, Lancs, England). Sept. 18, 1962. 20p.

A critical discussion of the crystal structure of alpha-uranium and a compilation of crystallographic data is presented. Parameters descriptive of various features of the unit cell are tabulated, together with values of functions required for the interpretation of crystallographic measurements. (auth)

14851 (TRG-Report-420) THE CREEP BEHAVIOUR OF MAGNOX AL80. L. R. T. Gardner and W. N. Miller (United Kingdom Atomic Energy Authority. Reactor Group, Springfields, Lancs, England). Oct. 26, 1962. 5p.

An empirical secondary creep law for Magnox AL80 is deduced from selected data and compared with a creep law due to Ward. An activation energy for creep is obtained. All available experimental results are used to suggest that extrapolation of the selected points by the laws considered leads to optimistic results at higher stress levels. "Proof" stresses are given for strain rates of 10^{-6}/hr, 10^{-5}/hr and 10^{-4}/hr for temperatures of 200, 250, 300, 400, 450, and 500°C. (auth)

14852 (UCRL-10598) PHYSICAL ASPECTS OF CREEP. John E. Dorn and Jim D. Mote (California. Univ., Berkeley. Lawrence Radiation Lab.). [1963]. Contract [W-7405-eng-48]. 135p.

A review of information and data on creep is presented. Known mechanisms are illustrated with recent data, and weaknesses in the creep theory are pointed out. (J.R.D.)

14853 (WADD-TR-60-581(Pt.III)) THERMAL PROPERTIES OF REFRACTORY MATERIALS. R. E. Taylor and M. M. Nakata (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 1962. Contract AF33(657)-7136. 18p. (AD-285236)

Improvements in the transient thermal diffusivity device are described. These improvements permit reproducible and accurate measurements to be made from 1300 to 1650°C. Data over this temperature range are presented on tantalum, titanium carbide, and zirconium carbide. The steady-state thermal conductivity apparatus was used to measure the thermal conductivity of zirconium carbide from 500 to 2100°C, and of one specimen of titanium nitride from 550 to 1200°C. The thermal conductivity behavior of zirconium carbide is similar to that of titanium carbide. Progress in specific heat and electrical resistivity measurements is described. (auth)

14854 (WAPD-T-1431) THE TENSILE PROPERTIES OF COLD-ROLLED AND ANNEALED HAFNIUM. J. G. Goodwin (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). May 5, 1962. Contract AT-11-1-GEN-14. 38p.

Equations relating tensile properties to the amount of cold reduction and testing temperatures are determined for iodide hafnium. Graphical presentations illustrating the effects of various heat treatments on the tensile properties of cold-reduced hafnium are included. The experimental work reveals a decrease in ductility as measured by elongation and reduction of area when heat treatments greater than 1652°F are employed. No corresponding change in strength values is noted. The information provided should aid in the selection of parameters for annealing iodide hafnium. (auth)

14855 (WAPD-T-1433) HARDNESS CONVERSION RELATIONSHIPS FOR HAFNIUM. J. G. Goodwin (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Mar. 28, 1962. Contract AT-11-1-GEN-14. 8p.

Relationships were developed for various hardness scales for hafnium. Hafnium strip, hot-rolled, was sheared, grit blasted, pickled, and cold reduced. Hardness deter-

mined on a plane normal to the rolling direction was related to the amount of cold reduction. The data were utilized to construct calibration curves for relating various scales. Equations were also derived for predicting values. (M.C.G.)

14856 (WCAP-1866) PREPARATION AND PRELIMINARY THERMOELECTRIC EVALUATION OF THE URANIUM CHALCOGENIDES. W. P. Blankenship (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Oct. 1961. Contract AT(30-3)-500. 45p.

Potential thermoelectric materials investigated were: US_x, USe_x, UTe_x, and some ternary combinations of U with S, Se, and Te. Procedures were developed for preparation of the various compounds, fabrication of geometrically regular samples, and determination of the thermoelectric properties of these samples as a function of temperature. Uranium-sulfur and uranium-selenium binary compounds, and uranium-sulfur-tellurium ternary compositions were found to offer considerable promise as good thermoelectric materials. The uranium-selenium group probably has the highest range of useful operating temperatures. (auth)

14857 (AEC-tr-5645) PHASE DIAGRAM OF THE Hf–HfC SYSTEM. R. G. Avarbe, A. I. Avgustinik, Yu. (Iu.) N. Vil'k, [Yu. D. Kondrashov, S. S. Nikol'skii], Yu. (Iu.) A. Omel'chenko, and S. S. Ordan'yan (Ordanian). Translated by Helen Chick and N. H. Krikorian (Los Alamos Scientific Lab., N. Mex.) from Zh. Prikl. Khim., 35: 1976-80(1962). 9p.

An investigation is described in which x-ray metallographic analyses were carried out and melting point measurements were made on Hf–HfC systems containing 11.8- to 50-at. % C. Results are tabulated and used in plotting several parts of a phase diagram of this system. (J.R.D.)

14858 (AEC-tr-5651) MAGNETIC STUDIES ON THE CARBIDES OF TITANIUM, ZIRCONIUM, HAFNIUM, VANADIUM, NIOBIUM AND TANTALUM. H. Bittner and H. Goretzki. Translated by Gretchen Riese (Los Alamos Scientific Lab., N. Mex.) from Monatsh. Chem., 93: 1000-4 (1962). 7p.

Magnetic susceptibility on pure monocarbide samples is measured as a function of the C deficiency. With increasing C deficiency, TiC_{1-x}, ZrC_{1-x}, HfC_{1-x}, and VC_{1-x} become more paramagnetic. Extrapolation to stoichiometric TiC leads to diamagnetism. NbC_{1-x} and TaC_{1-x} show a variation deviating from it; their susceptibilities decrease substantially with a rising C deficiency and reach diamagnetic values. A concept for the meaning of the susceptibility process on TiC_{1-x}, ZrC_{1-x}, HfC_{1-x}, and VC_{1-x} taking into consideration the binding energy in transition metals is developed and an explanation given for the magnetic behavior of mixed carbides. (auth)

14859 (AEC-tr-5674) INVESTIGATIONS ON THE COMPOUND FORMATION AND ELECTROMOTIVE BEHAVIOR OF CERIUM IN ITS ALLOYS WITH IRON AND ZINC. Fritz Clotofski. Translated from Z. Anorg. Allgem. Chem., 114: 1-23(1920). 21p.

The theory of binary mixtures can be used to calculate the potential differences between pure metal and alloy over the entire concentration range. Conclusions were drawn regarding the existence of chemical compounds and the magnitudes of the bond strengths related to these potentials. The cerium-iron system was investigated over the entire concentration range and the presence of CeFe and CeF_6 was established. Cerium-zinc alloys were investigated and the existence of Ce_4Zn and Ce_2Zn was demonstrated. For those alloys that formed compounds, a rapid rise in potential is exhibited at the mole fraction corresponding to compound formation. (H.G.G.)

14860 (AEC-tr-5678) THE ZINC–CERIUM AND ZINC–LANTHANUM SYSTEMS. Jakob Schramm. Translated from Z. Metallk., 33: 358-60(Jan. 1941). 8p.

Thermal, microscopic, and x-ray diffraction investigations of zinc–cerium alloys containing from 0 to 45% Ce and of zinc–lanthanum alloys containing from 0 to 40% La are discussed. (H.G.G.)

14861 (AERE-Trans-913) THE HIGH-TEMPERATURE OXIDATION OF MAGNESIUM–BERYLLIUM ALLOYS. V. E. Ivanov, V. F. Zelenskii, V. K. Khorenko, I. A. Petelguzov, B. V. Matvienko, R. F. Polyarzenko, L. A. Kornieko, and A. A. Korzhov. Translated by S. F. Pugh (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Autumn Meeting, French Society of Metals, Paris, October 15-19, 1962. 26p.

The oxidation of Mg–Be alloys was investigated by combining kinetic and structural observations. The structure and constitution of the oxide films were determined with the electron microscope and by electron diffraction, respectively. Oxidation was carrried out in air and in CO_2 at 470, 520, and 580°C. The protective action of Be was established. (M.C.G.)

14862 (EURAEC-515) STUDY OF EMBRITTLEMENT IN THE "AS QUENCHED" CONDITION. Special Report No. 10, July 1 to September 30, 1962. J. Dollet and C. Roques (Société Anonyme Des Forges et Ateliers du Creusot, Paris). Nov. 14, 1962. Work performed under United States–Euratom Joint Research and Development Program. 22p. (A Translation)

Results of a study concerning the effects of Al, Ti, V, Nb, Ta, Zr, and U on the brittle-ductile transition of basic-grade steel in the as-quenched condition are presented. (J.R.D.)

14863 (JPRS-17446) WORKS ON HEAT-RESISTING MATERIALS. Translated from Tr. Seminara po Zharostoikim Materialam, Akad. Nauk Ukr. SSR., Inst. Metallokeram, i Spets. Splavov, Kiev, 1958, 1-65(Pub. 1960). 146p.

A collection of information concerning the preparation and properties of refractory metals and their borides, carbides, nitrides, and silicides is presented. (J.R.D.)

14864 (JPRS-17750) ALLOYS OF RARE METALS WITH BORON AND SILICON FOR CERTAIN RADIO AND ELECTRICAL APPLICATIONS. G. V. Samsonov and V. S. Neshpor. Translated from p.392-417 of Redkie Metally i Splavy, Tr. Pervogo Vses. Soveshch. po Splavam Redkikh Metal., Akad. Nauk SSSR, Inst. Met., Moscow, 1957(1960). 31p.

Techniques for production and areas of application of refractory metal silicides and rare earth borides are investigated. Data and information are included concerning silicides of groups IV, V, and VI transition metals and rare earth borides. (J.R.D.)

14865 FRAGILITY OF BERYLLIUM. M. Weisz and Y. Adda (Section d'Etude des Metaux de Structure, France). Bull. Inform. Sci. Tech. (Paris), No. 62, 5-15(June 1962). (In French)

From a review of the most recent and surest experiments, it is shown that the fragility of beryllium depends on technological factors such as grain size and texture, but principally on the purity of the metal. The mechanisms of cleavage at low and high temperatures are discussed. (J.S.R.)

14866 BALANCE OF ENERGY AT HIGH-TEMPERATURE TORSION OF SINTERED UO_2. B. Živanović and M. M. Ristić. Bull. Inst. Nucl. Sci. "Boris Kidrich" (Belgrade), 13: No. 3, 31-9(Oct. 1962). (In English)

The behavior of $UO_{2.11}$ was investigated at high-temperature torsion in order to determine the characteristics of uranium dioxide precisely. From the experimental data on the characteristic twisting moments (taking into account the twist angle), the corresponding tangential stress and the total balance of energy at a high-temperature torsion of $UO_{2.11}$ were calculated. It was evident that the effect of the heat energy applied was essential to the strength of the sintered UO_2 at high-temperature torsion. (auth)

14867 THE MAGNETIC AND THERMAL BEHAVIOR OF NIOBIUM MONOCRYSTALS IN THE SUPERCONDUCTIVE STATE. Gérard Kuhn (Université, Grenoble, France). Compt. Rend., 255: 2923-5(Nov. 26, 1962). (In French)

Measurements of the magnetization and thermal conductivity of a niobium monocrystal as a function of an external magnetic field show the blocking of normal and superconductive regions by extended faults appearing especially during neutron irradiation. (tr-auth)

14868 STUDY OF THE PRECIPITATES IN THE Al–Ag (25%) ALLOY BY MEANS OF A VERY HIGH VOLTAGE ELECTRON MICROSCOPE. Gaston Dupouy, Frantz Perrier, and Noboru Takahashi (CNRS, Toulouse). Compt. Rend., 256: 545-7(Jan. 14, 1963). (In French)

The crystal precipitates in the Al–Ag (25%) alloy were studied under a voltage of 1 million volts. The structure of these crystals in the γ' phase was determined, and a dislocation lattice similar to that of Mo and graphite was observed. The field images seem to show that the moire fringes are produced between the matrix and the crystals of the γ' phase in the form of platelets. (tr-auth)

14869 STUDY OF THE ANODIC OXIDATION PRODUCTS OF IRON–ZINC AND IRON–COPPER ALLOYS AT AMBIENT TEMPERATURE. Jean-Marie Trautmann (Université, Louvain, Belg.). Compt. Rend., 256: 652-60 (Jan. 14, 1963). (In French)

The anodic oxidation products, at ambient temperature, of alloys with the formula 2Fe–Zn and 2Fe–Cu were studied. The formation of zinc ferrite in the first case and of magnetite in the second is shown. (tr-auth)

14870 MICROGRAPHIC AND RADIOCRYSTALLOGRAPHIC STUDY OF THE STRUCTURE OF URANIUM–NIOBIUM ALLOYS WITH 2.5 AND 5 at. % Nb TEMPERED FROM THE γ REGION. Claude Collot and René Faivre (Faculté des Sciences et E.N.S.N.I.M., Nancy and CEA, Saclay, France). Compt. Rend., 256: 661-3(Jan. 14, 1963). (In French)

The β phase of U–Nb alloys with 2.5 and 5 at. % Nb is practically not recoverable by tempering from the γ region. At cooling rates less than 20°C/sec, the laminar structure $\alpha + \gamma_1$ is obtained; between 20 and 80°C/sec, needles of the normal α phase; between 80 and 600°C/sec, needles of a martensite α phase analogous to that of U–Mo alloys. (tr-auth)

14871 DECOMPOSITION OF THE SOLID SOLUTION OF NIOBIUM AND TITANIUM IN CHROMIUM. N. V. Ageev and M. S. Model' (Baikov Inst. of Metallurgy, USSR). Dokl. Akad. Nauk SSSR, 148: 84-5(Jan.-Feb. 1963). (In Russian)

The study of the lattice constants of the solid solutions of Nb and Ti in Cr by x-ray diffraction methods indicated that the alloys undergo a complete decomposition. Examination of the microstructure and of the hardness changes as a function of the composition revealed that the boundary between the one- and two-phase regions in the Cr–Nb and the Cr–Ti systems lies between 2 and 3 atomic % Nb and 5 and 7 atomic % Ti, respectively. Changes in the lattice constants showed that the Cr–Nb alloys decompose slowly but noticeably at 820 to 850°C; the value of the constant ultimately reaches, or approaches within experimental error, that of pure Cr. Similar observations were made with the Cr–Ti solid solutions; however, while the Nb alloys decompose gradually, the Ti alloys undergo a "two-phase" decomposition. It was also found that the solubility of Ti in Cr at 1200°C does not exceed 0.3 to 0.6 atomic %; Nb possesses approximately the same solubility at 1000°C or at even lower temperatures. (TTT)

14872 THE SURFACE PROPERTIES OF CaF_2-BASED MELTS. Yu. P. Nikitin, V. G. Korpachev, and A. N. Safronnikov (Kirov Ural Polytechnic Inst., USSR). Dokl. Akad. Nauk SSSR, 148: 160-1(Jan.-Feb. 1963). (In Russian)

Previous studies on the dependence of the surface tension, σ, measured by the sessile drop method, on the composition of the melt pointed to a marked parallelism between σ and the ion fraction of $O(N_O 2-)$ in the case of CaF_2 containing melts in the temperature range between 1470 and 1550°C. Addition of 26 wt % of CaO to the CaF_2 increased the value of σ from 280 to 315 erg/cm^2. The measurements were carried out by determining the potential of the cell $Pt(I)/CaF_2$ (with traces of CaO/CaF_2–$CaO/Pt(II)$) in a technical N_2 atmosphere. Results indicated that the surface potential of melts containing 26% CaO is more electronegative by 28 mv than that of CaF_2. Study of the electrocapillary motion of metallic drops in the oxide–fluoride melt toward the anode indicated that the surface of the metal had a negative charge. Thus, exchanging F^- for O^{2-} ions reduces the negative charge of the metal surface. (TTT)

14873 YTTRIUM–TUNGSTEN OXIDES. Hans J. Borchardt (E. I. du Pont de Nemours and Co., Wilmington, Del.). Inorg. Chem., 2: 170-3(Feb. 1963).

WO_3 and Y_2O_3 react to form five compounds whose stoichiometry can be represented by the formula $WO_3 \cdot \chi(YO_{1.5})$, where χ has the values $^2/_3$, 2, $^{15}/_4$, $^3/_2$, and 6. The pseudobinary phase diagram of the system WO_3–Y_2O_3 was determined in part. The system Y_2O_3–WO_2 was investigated as well as the reactions of the several new phases with yttrium metal. This information, together with that resulting from studies of oxygen content, was used to arrive at the ternary composition diagram of the system W–Y–O. Some properties of the new phases are described. (auth)

14874 ULTRAHIGH STRENGTH MAGNESIUM AND BERYLLIUM ALLOYS. John C. McDonald (Lockheed Missiles and Space Co., Palo Alto, Calif.). J. Metals, 15: 136-40(Feb. 1963).

Recent developments in ultrahigh strength magnesium and beryllium alloys are presented. Initial costs and fabrication costs are reviewed briefly. Ultimate tensile strength, yield strength, and elongation values are given for the various alloy forms. Data illustrating the effect of temperature on Young's modulus for magnesium-alloy sheet and plate are also presented. (auth)

14875 ELASTIC CONSTANT — POROSITY RELATIONS FOR POLYCRYSTALLINE THORIA. S. Spinner, F. P. Knudsen, and L. Stone. J. Res. Natl. Bur. Std., 67C: 39-46(Jan.-Mar. 1963).

The relations between the elastic constants and porosity for about 300 thoria specimens were determined. Both Young's and the shear modulus for each specimen were obtained by a dynamic resonance method. From these two

moduli, Poisson's ratio was computed. The decrease in the elastic constants with increasing porosity was greater than would be expected from the theory. This greater decrease for the experimental values is attributed to the fact that the specimens do not conform to the idealized assumptions of the theory. (auth)

14876 G PHASES CONTAINING SCANDIUM. A. E. Dwight, R. A. Conner, Jr., and J. W. Downey (Argonne National Lab., Ill.). Nature, 197: 587(Feb. 9, 1963).

The composition and lattice parameters are presented for a G phase in Sc–Ni–Si, Sc–Co–Si. and Sc–Ni–Ge systems. (C.H.)

14877 OXIDATION OF PLUTONIUM IN MOIST AIR AND ARGON. J. B. Raynor and J. F. Sackman (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nature, 197: 587-8(Feb. 9, 1963).

The oxidation rate of Pu in air and in argon were compared under both dry and humid conditions at a temperature sufficiently low that changes in oxidation behavior were readily detected. Results indicate that oxidation is anodically controlled. (C.H.)

14878 UNUSUAL TWINNING IN GRAPHITE. John M. Thomas, E. E. Glenda Hughes, and Brian R. Williams (University Coll. of North Wales, Bangor). Nature, 197: 682-3(Feb. 16, 1963).

Twins were studied on the surfaces of over a thousand crystals of natural, Ticonderoga graphite. The crystals were frequently found to be composed of two or more flakes of highly perfect graphite twisted with respect to one another, with some twins intersecting the usual ones. Characteristics of these unusual twins are described. (C.H.)

14879 POSITIONS OF THE OXYGEN ATOMS IN $UO_{2.13}$. B. T. M. Willis (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nature, 197: 755-6(Feb. 23, 1963).

Uranium dioxide, UO_2, can dissolve oxygen at high temperatures to form the single phase UO_{2+x}, where x assumes any value in the range $0 \leq x \leq 0.25$. For $UO_{2.10}$ the temperature must exceed 600°C and for $UO_{2.20}$ the minimum temperature is about 1,050°C. Neutron diffraction investigations were made on a single-crystal of composition $UO_{2.13}$ with the aim of determining the positions of the oxygen atoms. Results are summarized from least-squares analysis, which was carried out using a Mercury computer program specially written for this work. The oxygen atoms in $UO_{2.13}$ occupy three different kinds of crystallographic site, and, as there are more equivalent positions for each site than oxygens to fill them, the oxygens are distributed at random among these positions. The program allowed as adjustable parameters the probability of occupation of each atomic site, as well as the atomic coordinates and temperature factors. The composition determined from the scattering results in $UO_{2.13}$ in agreement with that found chemically. (C.H.)

14880 MAGNETIC PROPERTIES OF MANGANESE FERRITES WITH ADDITIONS OF OXIDES OF RARE-EARTH ELEMENTS. (COMMUNICATION I). I. N. Frantsevich, A. I. Gunchenko, and L. N. Tulchinskii (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Poroshkovaya Met., Akad. Nauk Ukr. SSR, No. 5, 55-9(Sept.-Oct. 1962). (In Russian)

The effect of admixtures of oxides of Y, La, Ce, and Nd on the magnetic properties of manganese ferrites was studied. It is shown that the effect is not the same for various rare-earth oxides, depending on their content in the ferrite and the change in its structure. On the basis of the experimental data obtained, preliminary conclusions were drawn as to the possible mechanism of the effect of oxides of rare earth elements on the magnetic properties of manganese ferrite. (auth)

14881 EFFECT OF TEMPERATURE ON THE HARDNESS AND MODULUS OF ELASTICITY OF TUNGSTEN AND MOLYBDENUM (20°-2700°C). G. S. Pisarenko. V. A. Borisenko, and Y. A. Kashtalyan (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Poroshkovaya Met., Akad. Nauk Ukr. SSR, No. 5, 79-83 (Sept.-Oct. 1962). (In Russian)

The results of an investigation of the temperature dependences of the hardness and Young's modulus of W and Mo over a temperature range of 20 to 2700°C are presented. It was found that the temperature dependences of the hardness have two bends: a low-temperature bend at 0.14 to 0.2 and a high-temperature at a homologous temperature of 0.4 to 0.51. The temperature dependences of Young's modulus of the metals have only a single high-temperature bend at a homologous temperature of 0.5 to 0.55. The presence of bends is associated with the action of three basic mechanisms of plastic deformation at various homologous temperatures, as well as with a considerable change in the magnitude of the interatomic bonds at the high-temperature bend. (auth)

14882 THERMAL EXPANSION OF ZIRCONIUM–HAFNIUM ALLOYS. K. S. Pridantseva. Sb. Tr. Tsentr. Nauchn.-Issled. Inst. Chernol. Met., No. 25, 298-302(1962).

Zirconium alloys with Hf contents of 1.1, 2.6, 7.6, and 18% were tested in order to find alloys with a coefficient of thermal expansion close to that of alumosilicate ceramic materials. The tests were made with cast, vacuum-annealed specimens. The alloy with 7.6% Hf was also tested in forged condition. At all contents, Hf was found to extend the range of the roughly linear dependence of thermal expansion on temperature by raising the temperature of the $\alpha \rightarrow \beta$ transformation of Zr. This transformation causes a sharp change in the magnitude of the thermal-expansion coefficient of Zr. Alloys with 7.6 and 18% Hf retain the linear temperature dependence of thermal expansion up to 900°C. (P.C.H.)

14883 CRYSTAL STRUCTURES OF TERNARY COMPOUNDS IN THE SYSTEMS CERIUM–TRANSITION METAL–ALUMINUM. O. S. Zarechnyuk and P. I. Kripyakevich (L'vov State Univ.). Soviet Phys.-Cryst. (English Transl.), 7: 436-46(Jan.-Feb. 1963).

The crystal structures of the ternary compounds CeT_4Al_8 (T = Mn, Fe, Cu) and $Ce_2(T,Al)_{17}$ (T = Mn, Co, Cu) were determined. Compounds of analogous composition in the systems Ce–Fe–Al and Ce–Cu–Al were found to be isostructural with $CeMn_4Al_8$. For $CeFe_4Al_8$ the lattice periods were found to be a = 8.86, c = 5.08 Å, c/a = 0.573, and for $CeCu_4Al_8$, a = 8.84, c = 5.17 Å, c/a = 0.585. The distribution of atoms in the structures of the compounds is fully ordered. The parameters are assumed to be the same as for $CeMn_4Al_8$. In the systems Ce–Co–Al and Ce–Ni–Al, no compounds with type $ThMn_{12}$ structure were found. Data are tabulated. (P.C.H.)

14884 TECHNOLOGY AND PROPERTIES OF HEAVY CONCRETE. A. E. Desov, ed. Tr. Nauchn.-Issled, Inst. Betona i Zhelezobetona, No. 29, 1-160(1962). (In Russian)

Nine articles are included on experimental and theoretical studies of heavy and reinforced concretes. Technology of special steel aggregates with uniform shielding properties and of high-temperature concretes is discussed. Vibration and stress testing and results are considered. One

abstract of special interest was abstracted separately. (R.V.J.)

14885 TECHNOLOGY OF HEAVY RADIATION SHIELDING CONCRETES. A. E. Desov and V. I. Nadol'skii. Tr. Nauchn.-Issled. Inst. Betona i Zhelezobetona, No. 29, 4-36 (1962). (In Russian)

Experimental data are given on blast furnace dust and limonite used in preparing uniform shielding blocks and on methods for stacking special shielding walls. A table is given of heavy concrete weights and fillers with various specific weight and cement inclusion. General data are given on the diffusion of moisture at normal and elevated temperatures and on the prismatic strength of special concretes at elevated temperatures. Data are also given on γ effects on concrete strength and reinforcement corrosion. (R.V.J.)

14886 THE CRYOGENIC AND ELEVATED TEMPERATURE PROPERTIES OF "SUPER ALPHA" TITANIUM ALLOY WELDMENTS. D. R. Mitchell and D. L. Day (Titanium Metals Corp. of America, Toronto, Ohio). Welding J. (N. Y.), 42: 134s-44s(Mar. 1963).

Good welded properties were exhibited by all three of the advanced titanium-base sheet alloys with Ti-8Al-1Mo-1V and Ti-7Al-12Zr developing 10 to 15 ksi higher strength than Ti-5Al-5Sn-5Zr. Welded strengths were nearly equal to or surpassed the strength of the corresponding base metal. As-welded minimum bend radii were 4.0 to 6.0 T; tensile and bend ductility levels were moderately improved by postweld stress relief or annealing treatments. Weld strengths comparable to those of the base material were also observed at 800 and 1000°F, i.e., Ti-8Al-1Mo-1V and Ti-7Al-12Zr developed higher strengths than Ti-5Al-5Sn-5Zr. Good stability was obtained in as-welded sheet of the three compositions as creep exposed at 800°F. However, some deterioration of tensile elongation was noted after creep exposure at 1000°F, particularly in Ti-8Al-1Mo-1V and Ti-7Al-12Zr. Postweld duplex annealing at 1800 to 1850°F (5 min) ac + 1100°F (8 hr) markedly improved the stability of Ti-8Al-1Mo-1V, but annealing at 1650°F had little or no effect on the stability of welded Ti-5Al-5Sn-5Zr and Ti-7Al-12Zr. Creep resistance of as-welded Ti-8Al-1Mo-1V sheet was superior to that of the mill annealed base metal and was as good as or better than duplex annealed base metal. Thus, an improved combination of creep properties in the weld zone and adjacent base metal would be obtained by welding duplex annealed sheet or by duplex annealing after the welding operation. Resistance to creep of as-welded Ti-5Al-5Sn-5Zr and Ti-7Al-12Zr was comparable to that of the 1350°F (8 hr) mill annealed base metal; welded and unwelded creep properties were both greatly enhanced by annealing at 1650°F. However, the incomplete stress relieving treatment of 1100°F (1 hr) ac offered no improvement in welded creep resistance and stability of Ti-5Al-5Sn-5Zr and Ti-7Al-12Zr. Subzero temperature notch tensile strengths of welded and unwelded Ti-8Al-1Mo-1V exceeded the corresponding unnotched values at temperatures as low as -300 to -320°F using theoretical stress concentration factors (K_t) of 3.0 and 6.0. Subsequent duplex annealing of both welded and 1350°F mill annealed base Ti-8Al-1Mo-1V improved the subzero temperature notch properties, particularly in the base metal, at a sharper notch of $K_t = 8.0$. Higher unnotched ductility and notch strength ratios were measured at subzero temperatures in 1650°F annealed Ti-5Al-5Sn-5Zr unwelded sheet, compared to Ti-7Al-12Zr. In the as-welded condition, however, the low-temperature characteristics of the two alloys were similar except for the lower unnotched tensile elongation of Ti-7Al-12Zr. Postweld annealing at 1650°F improved the notch behavior and ductility of Ti-5Al-5Sn-5Zr; however, it had little beneficial influence on welded Ti-7Al-12Zr except for higher tensile elongation. Of the three alloys, Ti-8Al-1Mo-1V and Ti-5Al-5Sn-5Zr provided better cryogenic properties than Ti-7Al-12Zr. As measured by the relaxation of restrained base metal bend specimens, complete stress relief of all three alloys was achieved in short practical periods (5 hr or less) only by using higher temperatures of 1100 to 1300°F. Compared to treatments at 1100 or 1200°F, stress relief annealing at 1300°F (½ to ¾ hr) ac produced somewhat better weld ductility at strengths commensurate with those of the base metal. However, in the case of duplex annealed Ti-8Al-1Mo-1V, this cycle would provide lower base metal creep resistance than if a 1100°F postweld stress-relieving treatment were used. (auth)

14887 SELF-DIFFUSION IN MOLTEN POTASSIUM METAL. J. Rohlin and A. Lodding (Technische Hochschule, Goteborg). Z. Naturforsch., 17a: 1081-5(Dec. 1962). (In German)

The self-diffusion coefficient of liquid potassium was measured between 67 and 217°C by means of a capillary-reservoir method. The mean Arrhenius line calculated from the measurement values gave $D = 1.7 \times 10^{-3}$ exp (-2550/RT) cm^2/sec. The results indicate a significant dependence on the capillary diameter. (tr-auth)

Radiation Effects

14888 (BNL-6825) FUNDAMENTAL STUDY OF NEUTRON IRRADIATION ON THE PROPERTIES OF IRON AND OTHER BCC METALS. Progress Report to July 31, 1962. J. G. Y. Chow (Brookhaven National Lab., Upton, N. Y.). Contract [AT(30-2)-Gen-16]. 10p.

In order to establish the mechanism of radiation damage in pure iron and other bcc metals, a study of the mechanical properties and dislocation array in irradiated and unirradiated materials was made. The properties were studied over a range from room temperature to the temperature of liquid helium. Variables such as grain size, cold work, alloy additions, irradiation exposure, irradiation temperature, and post irradiation annealing were studied and results are presented. (H.G.G.)

14889 (GA-3599) FISSION-PRODUCT RELEASE FROM (Th,U)C_2-GRAPHITE FUELS. L. R. Zumwalt, E. E. Anderson, and P. E. Gethard (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Dec. 4, 1962. Contract AT(04-3)-314. 52p.

(Th,U)C_2 fuel particles coated with pyrolytic C had good Xe retention at first, but degradation occurred as high fuel burnup was achieved. Ba was found to permeate pyrolytic C coatings which were impermeable to Xe, particularly at temperatures above 1400°C. Retention of I_2 and Te by C coatings, although not quite as good as Xe retention, was much better than I_2 and Te retention by uncoated (Th,U)C_2 particles. In postirradiation annealing runs, the rate of release of Xe^{133} from coated and uncoated (Th,U)C_2 fuels was measured at 1000 to 1700°C. The release of Ba^{140}, Te^{132}, and I^{131} was also determined for lightly irradiated samples. Xe^{133} release was interpreted in terms of the "equivalent spheres" approach. Release rates for short-half-life Xe predicted by this treatment are in approximate agreement with steady-state Xe^{138} and Xe^{139} release rates obtained out-of-pile for uncoated (Th,U)C_2 particles by

using an electron linear accelerator to produce a steady rate of photofissions. Data for Kr^{85m}, Kr^{87}, Kr^{88}, and Kr^{89} were also obtained in these out-of-pile experiments. In-pile experiments on samples of coated particles were performed to determine the effects of high fuel burnup and temperature on the retention of Kr and Xe fission-product nuclides. Activation energies for release were found to be about 29 kcal/mole for Kr and 39 kcal/mole for Xe. (auth)

14890 (GA-3724) EFFECT OF NEUTRON IRRADIATION ON MATERIALS SUBJECTED TO MULTIAXIAL STRESS DISTRIBUTIONS. Quarterly Report, Period Ending September 30, 1962. T. A. Trozera (General Atomic Div. General Dynamics Corp., San Diego, Calif.). 6p.

Tensile tests were performed over the range −50 to 300°F on an unirradiated standard to develop data for comparison with tests of irradiated material. The Luders stress decreases uniformly from an average of 71,700 psi at −50°F to 60,800 psi at 300°F. (H.G.G.)

14891 (GA-3882) EFFECT OF NEUTRON IRRADIATION ON MATERIALS SUBJECTED TO MULTI-AXIAL STRESS DISTRIBUTIONS. Quarterly Report, Period Ending January 31, 1963. T. A. Trozera (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Feb. 13, 1963. Contract AT(04-3)-167. 6p.

The results of tests performed on simple tensile and notched tensile specimens (A302B Steel) are presented. Two simple tension tests run on each at −50, room, 150, and 300°F show very little scatter. Data indicate that the stress becomes temperature sensitive at ~200°F. The notched tensile tests yield values that are almost a factor of two higher than those obtained in simple tension and show considerable more scatter. (H.G.G.)

14892 (HW-SA-2917) ULTRASONIC TESTING OF IRRADIATED NPR FUELS. D. O. Hunter (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 12, 1963. Contract [AT(45-1)-1350]. 14p.

Methods for nondestructive ultrasonic testing of irradiated NPR fuels in an underwater facility at the test reactor are described. Bond testing, core integrity testing, and clad thickness measurements are discussed. The equipment is described. (M.C.G.)

14893 (NAA-SR-Memo-7872) PLANNING FOR URANIUM CARBIDE TRANSIENT HEATING EXPERIMENTS IN TREAT. M. Silberberg and P. Spiegler (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Oct. 17, 1962. Contract [AT(11-1)-Gen-8]. 24p.

The initial experimental program to study the transient heating of uranium carbide fuel in TREAT is outlined. Preliminary analyses are presented for the behavior of an HNPF prototype UC fuel slug during power bursts in the TREAT reactor. The analysis and evaluation conducted, center around the proposed utilization of the existing GE capsule, and indicate that this equipment will be suitable for the initial uranium carbide experiments with minor modification. A survey is presented and found not to be significantly different from the GE-UO_2 experiments. A planning schedule for the program is shown, and in addition, recommendations for additional studies which should be conducted are presented. (auth)

14894 (NMI-1255) IRRADIATION BEHAVIOR OF METASTABLE BETA PHASE URANIUM ALLOYS. Harry M. Green and Welville B. Nowak (Nuclear Metals, Inc., West Concord, Mass.). Dec. 13, 1962. Contracts AT(30-1)-1565 and AT(30-1)-2784. 36p. (NMI-TJ-52)

The behavior of neutron-irradiated, metastable beta phase uranium-base alloys has been investigated to determine whether such materials possess the stability to be a potential fuel for power reactor applications. Materials irradiated were unalloyed uranium, U−0.3 Cr, and U−0.3 Cr−0.3 Mo (wt %) with various metallurgical histories. The irradiation experiments were designed to yield maximum central metal temperatures of 450°C and burnups of 0.01 and 0.3 at. % in thermal neutron fluxes of 10^{13} nv; actual conditions produced temperatures 340 to 430°C and burnups of about 0.006 and 0.3 at. % in a flux of about 0.5×10^{13} nv. The data indicate that irradiation behavior of the beta phase uranium alloys is related to grain size, composition, and texture. In all cases the beta phase transformed to alpha in varying amounts depending upon the above metallurgical parameters. The most promising of these materials are the beta-quenched binary and ternary alloys, which exhibited a one percent increase in density compared to the one percent decrease of the alpha phase specimens. (auth)

14895 (NMI-7215A) EVALUATION OF RESTRAINT TUBES 132 AND 133. E. F. Jordan (Nuclear Metals, Inc., Concord, Mass.). June 14, 1962. Contract [AT(20-1)-1565]. 26p.

Detailed and summary data obtained in evaluation of restraint tubes 132 and 133 are presented. These tubes represent one of a set of 5 tube designs fabricated to test the effects of cladding restraint on fuel swelling during irradiation. Data evaluation results indicate that the tubes are of a quality similar to that of acceptable fuel tubes for HWCTR. (J.R.D.)

14896 (NMI-7215BC) EVALUATION OF RESTRAINT TUBES 130 AND 131. E. F. Jordan (Nuclear Metals, Inc., Concord, Mass.). June 20, 1962. Contract [AT(30-1)-1565]. 26p.

Detailed and summary data obtained in evaluation of restraint tubes 130 and 131 are presented. These tubes represent two of a set of five tube designs fabricated to test the effects of cladding restraint on fuel swelling during irradiation. Evaluation of results shows that the tubes are of a quality similar to that of acceptable fuel tubes for the HWCTR. (J.R.D.)

14897 (RAI-305) THE USE OF RADIATION INDUCED PLASTIC MEMORY TO DEVELOP NEW SPACE EXPANDABLE STRUCTURES. Quarterly Report, January 1, 1962−March 31, 1962. George Odian, Bruce S. Bernstein, Thomas Mann, James Kelly, Elliot Ratchik, P. M. Krishna, and Maurice Keesing (Radiation Applications Inc., Long Island City, N. Y.). Apr. 4, 1962. Contract NASr-78. 111p. (N62-11274)

The use of radiation-induced plastic memory to develop new space-expandable structures was studied. High and low density polyethylene were investigated, along with polyethylene acrylate copolymers. Some significant results of these studies follow: (1) Samples receiving 25 or more Mrads of radiation always showed complete restoration (within limits of observation) after transparency developed in the polymer under restoration heating. Unirradiated samples are partially restored but do not become transparent without partial melting and loss of coherence. (2) When the deformation temperature was below the minimum temperature, only nontransparency deformation was possible. Above this temperature, both types of deformation were possible. Studies of polyethylene samples of

various densities showed that, under NT deformation, the restoring forces were much greater than those under T deformation. This indicated that memory (i.e., complete restoration) is presumably due to crosslinking, causing restoration upon melting of the crystalline regions. (3) For NT deformed polyethylene, high density polyethylene, being more crystalline, had a greater restoration force than low density polyethylene. For T deformed polyethylene, the restoration forces of high and low density specimens were very similar, indicating that the crystallinity of the specimens were equivalent after T deformation. (4) Effect of the molecular weight of polyethylene on the restoring force is not conclusively determined because of the sparsity of pertinent data. Studies indicate that this effect is not appreciable. (5) Increasing the radiation dose causes a slight increase in the restoring force for the various polyethylenes but a marked decrease in the force of the polyethylene acrylate copolymer. (6) Thicker specimens were found to have greater restoring forces than thinner ones. (7) Quench conditions (i.e., the rate and temperature of cooling after deformation) appeared to have a very minor effect on the subsequent restoring force of the specimen. (8) The restoring force decreases as the angle of deformation decreases. This was true for both NT and T deformation conditions. However, the effect appeared greater in the case of NT deformations. (9) The minimum restoration temperature for high density polyethylene (Grex 50-050) was higher than that for low density polyethylene (Alathon 14), which in turn was higher than that for polyethylene acrylate copolymers. (auth)

14898 (REIC-Access-60) MONTHLY ACCESSION LIST NO. 60 [ON RADIATION EFFECTS DATA]. (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). Feb. 15, 1963. Contract AF33(657)-10085. 59p.

Approximately 174 references with abstracts are included on radiation effects on organic and inorganic compounds, electronic components, polymers, metal and ceramics, and other subjects related to radiation effect studies. The period July 1, 1962, to January 31, 1963, is covered. Availability of each article is indicated when possible. (D.C.W.)

14899 (TID-17935) INVESTIGATION OF IRRADIATION EFFECTS IN SOLIDS. Annual Report, 1962. Rohn Truell [Brown Univ., Providence. Graduate Div. of Applied Mathematics]. Contract AT(30-1)-1772. 22p.

Results of a study concerning the interaction of paint defects with dislocations and the related effects on dislocation damping in Al and NaCl under Co^{60} irradiation are presented. Evidence of dislocation resonances in Al was obtained with a maximum appearing in the ultrasonic decrement-frequency curve or the equivalent inflection, and leveling off in the corresponding attenuation-frequency curve. Other work is reported on effects of reactor and Co^{60} irradiation on α quartz. Results show that both types of irradiation put a peak in the ultrasonic attenuation-temperature curves at 250 to 300°C and cause the attenuation to increase at temperatures lower than with unirradiated samples. (J.R.D.)

14900 (TID-17964) MECHANISMS OF ATOMIC DISPLACEMENTS INDUCED BY RADIATION. A. Sosin Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). [Oct. 1, 1962]. Contract [AT (11-1)-Gen-8]. 71p.

A review of theory concerned with collision processes in irradiation of metallic materials is presented. The nature of an original collision is examined along with subsequent displacement processes such as primary displacements, secondary displacements and cascades, thermal displacement spikes, and focusing. (J.R.D.)

14901 (TRG-Report-360) A COMPENDIUM OF X-RAY GROWTH INDICES FOR MECHANICALLY WORKED URANIUM. G. F. Slattery and D. E. Connolly (United Kingdom Atomic Energy Authority. Reactor Group, Springfields, Lancs, England). Sept. 21, 1962. 31p.

The development of a method for mathematically formulating sets of p-values into a single index, descriptive of the amount of irradiation-growth to be expected in the material to which they refer is reviewed. Growth indices computed for uranium are presented and their implications discussed. For uranium rolled within controlled temperature ranges, the growth index decreases with increasing temperature of rolling for a given reduction in area. Rolling at room temperature builds up a single (010) texture rapidly with increasing reduction. The compression texture is centered around the [114], [113], and [112] pole directions. After 40% reduction, the [100] poles are aligned transverse to the rolling direction. The growth index in the rolling direction increases with increasing deformation. Beta heat-treatment of rolled uranium followed by water quenching substantially reduces the growth index. The texture of extruded uranium varies along the length of the rod. This variation can be correlated with microstructure. At the front of the rod, there is a duplex (010)(110) texture associated with warm extrusion. In the middle, the texture is (130) to (131) which is more representative of a recrystallization texture. At high reductions and temperatures in extrusion, a predominantly (100) texture is developed leading to a negative growth index. A single beta-quenching operation reduces the texture in extruded uranium, particularly the [100] component. Subsequent beta quenching appears to regenerate the texture. The effect of small additions of molybdenum, chromium, and aluminum on the hot rolled textures of uranium is to increase the (010) tension texture and reduce the (110) texture. For the same temperature of hot rolling, the uranium alloys have a higher growth index compared with unalloyed uranium. (auth)

14902 (WAPD-TM-332) POST-IRRADIATION EVALUATION OF A PLATE-TYPE UO_2 FUEL ELEMENT. H. B. Meieran (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Jan. 1963. Contract AT(11-1)-Gen-14. 81p.

The premature failure of fuel Element M22, which had six compartments of 0.100-in.-thick, 96% TD UO_2 + 6 wt % ZrO_2 fuel, was attributed to the large irradiation-induced solid volume swelling of the UO_2 fuels. This volume swelling was the result of incomplete homogenization during fabrication of the mixed and sintered U^EO_2 and U^NO_2 fuels in Element M22. In addition, heavy hydriding of the Ni-free Zircaloy-2 cladding occurred in the relatively hot areas adjacent to the fuel and to a lesser extent at the external cladding surfaces. By postulation, H_2 was apparently formed by the radiolytic decomposition of water entrapped between fuel and cladding after formation of the initial cladding defect, and was absorbed by the cladding so rapidly that it could not diffuse adequately down the thermal gradient to the cold side of the cladding. The corrosion behavior of the cladding was as expected and did not contribute to the hydriding. Analysis of the CR-X-3 loop operating history indicates that no abnormal conditions external to Element

M22 existed in the loop other than U from inpile intentionally defected fuel elements. (auth)

14903 THERMAL TEMPERING AFTER NEUTRON IRRADIATION IN THE CASE OF SOME NICKEL COMPLEXES. A. Ruşi and S. Ionescu (Inst. of Atomic Physics, Bucharest). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 13: 605-14(1962). (In Rumanian)

The tempering of thermally treated nickel exposed to the (n,γ) reaction, with the nickel in the form of complexes and principally in hexammine nickel nitrate was studied. The experimental curves describing the tempering process at various temperatures show a close resemblance to the tempering of the cobalt in the hexammine cobalt. A linear dependence of the lg $(R_\infty - R_t)$ values as a function of the tempering time was observed. The exponential character of the process results. The graphs of $(R_t - R_0)$ and ln t at various temperatures indicate the linear portions are displaced toward shorter times at higher temperatures. By relating them to the curve considered at 75°C along the time axis, a total curve is obtained which describes the complete restoration process by the equation $P = R_{\infty max}(1 - e^{-t/10^9})$. The tempering property is also shown distributed into activation energies; its spectrum has a maximum for E = 0.77 ev. A comparison between the values characterizing the tempering of Ni and that characterizing the tempering of Co shows both generalities and individualities. (tr-auth)

14904 SPATIAL DISTRIBUTION OF RADIOINDUCED FAULTS IN SOLIDS WITH THE RIGID SPHERE APPROXIMATION. D. Grecu (Inst. of Atomic Physics, Bucharest). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 13: 615-30(1962). (In Rumanian)

In a previous work the function of spatial distribution of a cascade of displaced atoms produced around a primary atom of random energy was determined. Integral equations were obtained for the mean values of the products (up to the third degree) of the vector components of the final position of the primary atom. In the present work, the asymptotic solutions ($R \gg a$) found for $\overline{Z}$, $\overline{R^2}$, and $\overline{Z^2}$ in the rigid sphere approximation are presented. From these the mean square deviation is calculated and the distribution function is expressed in the form of Gaussian functions. After an evaluation of the time interval for the formation of the cascade of displaced atoms, their evolution is analyzed as a function of time and temperature in the region of arrest of these atoms under the hypothesis that at the initial moment (after the arrest of all the atoms) the temperature distribution itself is Gaussian. The conclusion is thus reached that whatever the time t the temperature distribution always remains Gaussian. By taking into consideration the fusion temperature of the metal, a condition is introduced which permits the determination of the mean life of the region where the metal is melted. (tr-auth)

14905 EFFECTS OF IRRADIATION ON THE OPTICAL REFLECTION OF SOME IRRADIATED CERAMICS AND GLASSES. C. Moţoc (Inst. of Atomic Physics, Bucharest). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 13: 687-94(1962). (In Rumanian)

The effect of neutron irradiation on glasses with very complex composition and on some ceramics with the same composition, obtained from these glasses, was studied. It was established that the effect on the relative variation of the reflection factor as a function of the wave length is not the same for the irradiated ceramics and glasses. The differences appear both in the form of the reflection spectrum and in the value of the ratio between the reflection factor of the irradiated sample and that of the nonirradiated sample. The modifications of the reflection properties of the irradiated are due, on one hand, to the creation of color centers following the irradiation and, on the other hand, to the surface corrosive action of the irradiation medium. The differences between the reflection spectra of the irradiated glasses and ceramics can be attributed to some inhibitors which in the crystallized phase, contained in the substance in the ceramic form, do not manifest this effect. (tr-auth)

14906 PROTON INDUCED LATTICE DISPLACEMENTS IN SILICON. J. A. Baicker, H. Flicker, and J. Vilms (RCA Labs., Princeton, N. J.). Appl. Phys. Letters, 2: 104-6(Mar. 1, 1963).

The rate of lattice displacement production in silicon by protons have been calculated using elastic scattering cross sections and are compared with experimental values. Rates recalculated assuming four different threshold energies for ionization production by a recoiling Si atom are also given. (D.C.W.)

14907 INVESTIGATION OF THE RADIATION STABILITY OF BIPHENYL IN A DYNAMIC LOOP. R. Haeberli, W. Haelg, and J. L. Meylan (Eidgenössisches Institut für Reaktorforschung, Würenlingen, Switzerland). Atomkernenergie, 7: 385-91(Nov. 1962). (In German)

A loop for the irradiation of organic coolants in a reactor core and operating experience with diphenyl are described. Rates for polymer formation and gas evolution as a function of the radiation dose are measured and the corresponding G values are compared with the literature. (auth)

14908 IRRADIATION CAPSULES FOR ORGANIC SUBSTANCES. CONSTRUCTION AND FIRST RESULTS IN IRRADIATION OF BIPHENYL. G. A. Melkonian, C. Salander, and E. vom Baur (Reaktorstation, Geesthacht/Elbe, Ger.). Atomkernenergie, 7: 411-18(Nov. 1962). (In German)

The construction of simple and instrumentated aluminum capsules containing several special quartz ampoules for reactor irradiation of organic compounds is described. Problems and first results of diphenyl irradiation are discussed. An apparatus for gas yield measurements is described and first experimental results of dose-dependent gas formation rate as well as G_{Gas} and $G_{Polymer}$ values are reported and discussed. (auth)

14909 MATERIALS TESTING WITH THE RCN HIGH FLUX REACTOR. J. J. M. Snepvangers. Atoomenergie Haar Toepassingen, 4: 257-71(Nov. 1962). (In English)

Equipment and results are described connected with irradiation studies of UO_2 fuels, fuel element testing in pressurized water loops, graphite irradiation, and steel irradiations with and without temperature control. The apparatus described is associated with a 20-Mw pool-type research reactor. (T.F.H.)

14910 BERYLLIUM UNDER IRRADIATION: EVOLUTION OF MECHANICAL PROPERTIES. J. Polge. Bull. Inform. Sci. Tech. (Paris), No. 62, 60-3(June 1962). (In French)

A survey is made of the most important and recent studies on the evolution of the mechanical properties of Be under irradiation. The effects considered are swelling or density variations, fragilization, and tube rupture. The results of electron microscopic studies are briefly summarized, and the theoretical considerations are mentioned. (J.S.R.)

14911 EFFECT OF NUCLEAR IRRADIATION ON THE AGING OF NIMONIC TYPE ALLOY. V. G. Cherni and

Y. A. Guslienko (Inst. of Metallurgy, Academy of Sciences, Ukrainian SSR). Dopovidi Akad. Nauk Ukr. RSR, No. 11, 1453-5(1962). (In Ukrainian)

An investigation was made of the effect of irradiation with neutrons on the decomposition of a hardened nickel–chromium–aluminium–titanium alloy. The hardness of the alloy, the quantity of intermetallic phase, and its state were determined. It is shown that the effect of irradiation is manifested in different ways in samples of different thickness. The effect of irradiation leads to more marked results in the case of samples of lesser diameter. (auth)

14912 INVESTIGATION OF THE EFFECT OF GAMMA-RAYS, X-RAYS AND NEUTRONS UPON SEMI-CONDUCTOR RECTIFIER SYSTEMS. CdS–Se AND CdSe–Se (Thesis). M. A. Talibi and G. B. Abdullaev. Fotoelektr. i Optich. Yavleniya v Poluprov. Tr. 1-go [Pervogo] Vses. Soveshch., Kiev, [1957,] 401(1959).

The effect of light, gamma and x rays, and neutrons on the electric properties of semiconductor rectifier systems, CdS–Se and their elements was investigated. The rectifier characteristics were investigated in the photodiode range, and the values of the barrier EMF and the internal resistivity of the elements were calculated using a graphical method. It is shown that the photo- and dark-components of the conductivity of CdSe–polycrystals change linearly with increase of the voltage applied to the sample, and they do not depend upon the kind of incident radiation. (P.C.H.)

14913 EMISSION OF FISSION PRODUCTS FROM A SAMPLE OF URANIUM PLACED IN A PILE: EXPERIENCE "ORPHEE." F. Duhamel, F. Billard, L. Fitoussi, J. Miribel, and J. Pradel (Centre d'Etudes Nucléaires, Saclay, France). Health Phys., 9: 13-14(Jan. 1963).

The studies undertaken with the "ORPHEE" produced the expected results as well as some not anticipated at the start of the program. The results of the measurements that were carried out make it possible to estimate approximately the importance of these various phenomena and to apply them to suitable cases, for instance, a reactor. The filtration experiments permitted the collection and identification of the descendants of very short-lived gases, such as Xe^{141}, Xe^{143}, Xe^{144}, as well as the daughters of longer-lived gaseous fission products, and daughter products which decay from nongaseous elements such as Te^{129}, Te^{131}, Te^{132}, and Mo^{99} which previously had seemed improbable. Three release processes of fission products were assumed: gaseous diffusion, recoil effect, and the diffusion of elements in the form of gaseous chemical compounds. Different processes were noticed between isotopes of certain elements such as tellurium and iodine. These differences remain unexplained. The efficiency of filters and traps used with respect to various fission products was determined, and it was deduced that solid daughter products of gaseous parents acted in the same manner as the active daughter products of radon or thoron. This contributed to the justification of the use of radon and thoron daughters for the testing of filtering materials. The results obtained indicate that further study by more systematic measures would be worthwhile. The construction of a more ambitious plant permitting attainment of a pressure around 20 kg/cm^2, a temperature of 1000°C, and more importantly, conditions approaching those of the gas cooled reactor, has already been planned. (auth)

14914 OPTICAL GLASS IN NUCLEAR PHYSICS AND NUCLEAR TECHNOLOGY. INTERACTIONS BETWEEN ENERGETIC RADIATION AND GLASSES. R. Fischer. Isotopen Tech., 2: 360-3(Dec. 1962). (In German)

The behavior of a series of optical glasses under the effect of high doses of energetic wave radiation was investigated. The discolorations of some lead glasses under irradiation were discussed in dependence on the PbO content. Ordinary optical glasses are basically unsuitable when they are exposed to radiation charges of more than 10^8 r. In such cases only specially fused radiation-resistant glasses can be used. An assortment of radiation-resistant glasses were developed. (tr-auth)

14915 SURFACE ELECTRON EMISSION OF RADIO CERAMICS IRRADIATED BY GAMMA RAYS. A. M. Belonogov and A. A. Yevgrafov. Izv. Leningrad. Elektrotekh. Inst., No. 46, 344-5(1961).

The results of a study on low-temperature electron emission from the surface of dielectrics subjected to ionizing radiation are reported. Specially developed equipment with an open point counter, operating at atmospheric pressure, was used for recording the emission. At 360°C the intensity of emission was measured as about 1000 pulses/sec (natural background emission was 1 to 2 pulses/min.). When titanium-containing ceramics were irradiated with gamma rays, an emission maximum was observed that corresponded to the emission peak at 360°C from the surface of partially reduced rutile. (Emission peak was also observed in a Ti-ceramic aged in electric field). It is also shown that ceramic material with a sharp tendency to age in an electric field had an emission peak at 140°C whereas more stable materials had no such peaks. At temperatures around 450°C, emission was observed in all cases. (P.C.H.)

14916 THE INFLUENCE OF MOLECULAR WEIGHT DISTRIBUTION ON THE SOLUBILITY ANALYSIS OF IRRADIATED RUBBER. D. T. Turner (Research Triangle Inst., Durham, N. C.). J. Polymer Sci., Pt. B, 1: 93-5 (Feb. 1963).

A polymer with an average of u units/molecule gives a sol fraction s after a radiation dose R which may be related to the probabilities of fracture (p) or crosslinking (q) per unit dose by the equation: $s^{\frac{1}{u}} = pq^{-1} + (quR)^{-1}$. Results are reported for rubber whose molecular weight was randomized by thermal oxidation prior to irradiation by 4-Mev electrons. The data, plotted on a $s^{\frac{1}{u}}$ vs 1/R graph, agrees with the equation at higher doses, whereas the data for a nonrandomized sample does not. (D.L.C.)

14917 THE ROLE OF AN ADDITIVE IN REDUCING NETWORK FORMATION ON IRRADIATION OF RUBBER. D. T. Turner (Research Triangle Inst., Durham, N. C.). J. Polymer Sci., Pt. B, 1: 97-9(Feb. 1963).

A sample of high-molecular-weight rubber was used in order to study radioinduced gelation in the presence of nitrobenzene. The sample was irradiated with 4-Mev electrons, and the data were plotted on a $s^{\frac{1}{u}}$ vs 1/R graph. It is concluded that nitrobenzene suppresses ~40% of the crosslinks; the previously reported high value of 70% is believed to include network destruction due to increased chain fracture in the presence of the additive. (D.L.C.)

14918 THE INFLUENCE OF THE TEMPERATURE OF IRRADIATION ON THE FORMATION OF POLYMER NETWORKS. D. T. Turner (Research Triangle Inst., Durham, N. C.). J. Polymer Sci., Pt. B, 1: 101-3(Feb. 1963).

A sample of high-density polyethylene (Marlex 50) was irradiated with 4-Mev electrons in vacuum at 25 and −196°C. The results show that, on lowering the temperature, the yield of crosslinks is scarcely affected, while the yield of fractures is increased. It is concluded that the hydrogen-crosslinking mechanism is still valid. (D.L.C.)

14919 EFFECT OF IMPURITIES ON γ-IRRADIATION HARDENING OF SODIUM CHLORIDE CRYSTALS. Touichi Okada and Tokuo Suita (Osaka Univ.). Nippon Genshiryoku Gakkaishi, 5: 2-7(Jan. 1963). (In English)

The radiation hardening effect in sodium chloride single crystals (a large increase in the yield stress in compression by γ irradiation and its thermal recovery) were investigated. The effects of Ag and Ca ions, which are respectively monovalent and divalent impurity, on the thermal healing of the radiation-induced hardening and optical absorption were studied. It was found that the thermal stability in radiation hardening was not affected by Ca ions but was influenced by Ag ions and that the thermal recovery of the hardening lags behind the vanishing of color centers. (auth)

14920 THERMOLUMINESCENCE AND DIELECTRIC LOSS OF BARIUM TITANATE CERAMIC UNDER X-RAY IRRADIATION. K. V. Rao and H. N. Bose (Indian Inst. of Tech., Kharagpur). Proc. Natl. Inst. Sci. India, Pt. A, 28: 573-7(July 26, 1962).

The thermoluminescence and dielectric loss of barium titanate ceramic under x irradiation are investigated. The irradiated sample exhibits thermoluminescence in the temperature region 180 to 420°C with a peak around 330°C. X irradiation of the sample at room temperature is found to increase its dielectric loss which, on heating the sample to about 400°C, is reduced to its original value. The excess dielectric loss $\Delta \tan \delta$ of the irradiated sample over that before x irradiation is removed in two stages with heating: the first part is found to be removed by heating the sample to any temperature between 110 and 180°C, i.e., to a temperature below the onset of thermoluminescence emission. The second part disappears when the sample is heated above 400°C showing that this part is connected with thermoluminescence. The results seem to indicate that, in barium titanate ceramic, the trapped electrons or holes can, by their electrostatic interaction, inhibit the formation and movement of domains in ferroelectric materials, and thereby affect the hysteresis loss. (auth)

14921 ON THE POSSIBILITY OF FABRICATING p-n JUNCTIONS BY IRRADIATING SILICON WITH ALPHA PARTICLES. N. I. Golovina. Tr. Novocherk. Politekhn. Inst., 118: 65-7(1961).

The possibility of fabricating p-n junctions in p-type Si subjected to α-particle irradiation was examined. Since P, the donor impurity in Si, comes immediately after Si in the periodic table, it is possible to introduce it during the α-particle irradiation of Si. The nuclear reactions taking place in Si under the action of α-particles are considered. The energy required of α-particles, the reaction cross section, the concentration of P atoms, and the penetration depth of particles are calculated. According to the calculations, the irradiation of p-type Si by ~10-Mev alpha particles should result in p-n junctions at ~20-μ depth. If the hole concentration in the initial material is $\sim 10^{15}$ cm^{-3}, the α dose should amount to $\sim 10^{18}$ cm^{-2}. The path length of 10-Mev α particles in Si is 60 μ. (OTS)

14922 EPR STUDY OF THE RADIATION VULCANIZATION OF RUBBER IN THE PRESENCE OF SULFUR AND HEXACHLOROETHANE. Z. N. Tarasova, M. S. Fogel'son, V. T. Kozlov, A. I. Kashlinskii, M. Ya. Kaplunov, and B. A. Dogadkin. Vysokomolekul. Soedin., 4: 1204-9(1962).

Recorded epr spectra were used to study the formation of free radicals during the radiation polymerization of natural rubber (NR) and mixtures of NR with 2 wt % sulfur or 10 wt % C_2Cl_6. Irradiation was conducted at –196 to 20°C with Co^{60} at a dose of 6 to 11 Mr with the following results: long-lived radicals with an initial concentration of (1 to 2.5) $\times 10^{14}$ mg^{-1} formed in NR and its mixtures with S or C_2Cl_6 at 20°C and 6 to 8 Mr; radicals of different lives formed with irradiation at –196°C. (Their initial concentrations in NR, NR + C_2Cl_6 and in NR + S were $(4.9 \pm 0.7) \times 10^{15}$ mg^{-1}, $(11 \pm 2) \times 10^{15}$ mg^{-1}, and $(2.6 \pm 0.6) \times 10^{15}$ mg^{-1}, respectively.) If the NR + C_2Cl_6 sample irradiated at –196°C was slowly brought to room temperature, structuration occurred near the vitrification temperature (–70°C); gradual heating of the NR + S sample yielded new short-lived radicals with a g factor typical of S radicals; after irradiation, crystalline C_2Cl_6 showed an intensive epr signal (the formation of CCl_3 radicals was confirmed by the analytical detection of chloroform); structuration of NR irradiated at low temperatures was supported by C_2Cl_6 and impeded by S, which increased the static strength of the radiation vulcanizate; and crystalline S showed only a weak epr signal. (P.C.H.)

PHYSICS

General and Miscellaneous

14923 (AASU-213) ELECTRON-ION RECOMBINATION IN ARGON FLOWING THROUGH A SUPERSONIC NOZZLE. K. N. C. Bray (Southampton, England. Univ.) Mar. 1962. Contract AF61(052)-250. 44p. (AD-283485; N62-12405)

Recombination of electrons and ions in highly ionized argon plasma expanding through the supersonic nozzle of a low-density arc-heated wind tunnel is treated assuming that recombination occurs via the first excited state of the atoms. De-excitation is then the rate limiting step. Quasi-one-dimensional flow equations are used, and other recombination mechanisms are briefly discussed. Analysis of numerical calculations reveals the mechanism would lead to an electron temperature much greater than the atom-ion temperature. Results also indicate that the flow through nozzles under typical practical conditions would be far from the equilibrium and frozen flow points. (D.C.W.)

14924 (AD-278451) THERMOELECTRIC MATERIALS. Bi-Monthly Progress Report No. 11, September 1–October 31, 1961. Merton H. Brooks (Titanium Alloy Mfg. Div., National Lead Co., Niagara Falls, N. Y.). Contract NObs-78326. 10p.

Preparation of CeO_2 ceramic materials with additions of Y_2O_3, La_2O_3, and Nb_2O_5 is reported. Data on composition and properties of these materials are tabulated. It was found that although these bodies are not well sintered at 2900°F, they are badly over-fired at 3000°F. Standard ceramic bodies were also fabricated from $PbNb_2O_6$ and $Pb_2Nb_2O_7$ with additions of CdO, Bi_2O_3, Sb_2O_5, MoO_3, and WO_3. Data on these materials are included. Results obtained in electric conductivity and Seebeck coefficient measurements on forty-two CeO_2-base compositions are also included. (J.R.D.)

14925 (AD-278817) EVALUATION OF A MOLYBDENUM EMITTER, LOW VOLTAGE ARC THERMIONIC POWER CONVERTER. Quarterly Technical Progress Report No. 1. E. A. Baum (General Electric Co. Power Tube Dept., Schenectady, N. Y.). Aug. 1962. Contract AF33(657)-8323. 22p.

Initial work is reported in a program to define and minimize the life-limiting factors affecting the usefulness of low-temperature Cs vapor thermionic converters. The program is basically directed toward life test evaluation of state-of-the-art vapor converters utilizing Mo cathodes. During the report period, design of the life test equipment was completed and fabrication started. Preliminary tests were made on one device. (J.R.D.)

14926 (AD-296893) RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM. Twelfth Quarterly Progress Report, September 16, 1962–December 15, 1962. R. Novick (Columbia Univ., New York. Columbia Radiation Lab.). Dec. 15, 1962. Contracts DA-36-039-SC-78330 and DA-36-039-SC-90789. 64p.

Evidence has been found for the existence of the $(1s\ 2s\ 2p)^4P_{\frac{5}{2}}$ metastable state of the lithium atom. This state decays by autoionization with a lifetime of about 10 μsec. In addition to its intrinsic interest, this state and similar states in other atoms warrant study because they may serve as useful sources of polarized electrons and ions. Final results are reported on the magnetic moment of O^{15}. Precise values for the zero field hyperfine intervals and the level crossing fields of 245 day Zn^{65} are reported. The spin, magnetic moment, and quadrupole moment of 43 day Cd^{115m} have been determined by optical double resonance. Theoretical calculations of the moments of the cadmium and zinc isotopes have been made on the basis of the configuration mixing model; these are compared with the experimental values. New precise values of the HDS molecular parameters have been deduced from the measurements reported previously. Initial results are reported on the optical maser spectroscopy program. In the cooperative radioastronomy program with the Naval Research Laboratory, it has been found that the 3200 Mc/sec radiation from Saturn is linearly polarized and that the magnetic poles of Saturn appear to be located in the equatorial plane of the planet. (auth)

14927 (AGC-0528-01-2) INVESTIGATION OF AN ENERGY CONVERSION DEVICE. Quarterly Progress Report No. 2, October 1 to December 31, 1961. R. F. Fogle and H. E. Lawson (Aerojet-General Corp., Azusa, Calif.). May 1962. Contract DA-36-039-SC-87229. 9p. (AD-278480)

Activities in a program to develop a cell which produces electricity by recombination of thermally separated reactive elements are reported. Tests are reported in which reactants were lost from the cell during operation because of mechanical failure of the sealing materials; however, in intermittent tests, operation was increased to about 8 days. (J.R.D.)

14928 (ASD-TDR-62-324) THE DEVELOPMENT OF A LOW TEMPERATURE VAPOR FILLED THERMIONIC CONVERTER. F. G. Block and J. J. O'Grady (Radio Corp. of America. [Electron Tube Div.], Lancaster, Penna.). Apr. 5, 1962. Contract AF33(616)-7903. 168p. (AD-278810)

Applied research toward developing a low-temperature, plasma, thermionic converter is described. A third electrode is used in the converter to ionize plasma so as to neutralize the space charge. The lower temperature thus achieved should significantly prolong the life of the converter and contribute to the development of a more reliable power supply for space application. The program was directed toward optimizing geometry and operating characteristics and investigating the effects of temperature and pressure, starting pulse, magnetic fields, and operation in both series and parallel circuitry. Materials were investigated to achieve practical electrodes by determining compatibility of material, atmospheric corrosion, and gas permeation. Converters were fabricated, evaluated, and life tested with the parameters optimized by the test program. (auth)

14929 (ASD-TDR-62-598) AN EVALUATION OF A CESIUM MAGNETIC TRIODE. E. N. Carabateas, G. Miskolczy, and A. Wolpert (Thermo Electron Engineering Corp., Waltham, Mass.). June 1962. Contract AF 33(616)-8204. 130p. (AD-278844)

General equations are derived for a magnetic triode and design parameters are obtained. Experimental models were constructed with provisions to vary parameters. The models were fabricated using all metal-ceramic components to achieve uniform test conditions and to demonstrate the extent to which a device incorporating the magnetic triode features can be made practical both from the

point of view of ruggedness and that of adaptability to a heat source. Extensive experimental results are obtained in an ignited and in an unignited mode. An analysis of the experimental results is presented. (auth)

14930 (CEA-Bib-33) GENERATEURS D'ENERGIE ELECTRIQUE ET IRRADIATEURS EQUIPES DE SOURCES DE PRODUITS DE FISSION AUX U.S.A. (Electrical Energy Generators and Irradiators Equipped with Fission Product Sources in the U.S.A.). H. Emmanuel (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1962. 10p.

Tables of information on research and applications achieved in U.S.A. in the fields of isotope-fueled power generators, and irradiation facilities equipped with fission product sources are presented. (auth)

14931 (CLM-Bib-3) CRYOGENIC MAGNETS. A BIBLIOGRAPHY. C. S. Sabel, comp. (United Kingdom Atomic Energy Authority. Research Group. Culham Lab., Culham, Abingdon, Berks, England). Nov. 1962. 16p.

One hundred thirty-seven references are included to articles published up to April 1962 on cryogenic magnets. (D.C.W.)

14932 (CX-59) A MODEL FOR THE STATISTICAL ATOM WITH NONVANISHING ANGULAR MOMENTUM. Research Report. Judah L. Schwartz and Sidney Borowitz (New York Univ., New York). Dec. 1962. Contracts AF19(604)-4555; DA 30-069-ORD-2581; and Nonr-285(49), NR 012-109. 39p. (AFCRL-62-1089; AROD-2360.23; AD-295053)

In the first of the coupled integro-differential equations satisfied by the Green's functions of the many body system the Hartree-Fock approximation is made for the two particle Green's function. The resulting equation is written in a mixed position-angular momentum representation in such a way that use may be made of whatever empirical information about the angular momentum of the system is available. In the mixed position-angular momentum representation the one particle Green's function appears as a sum of terms each of which corresponds to a different value of the angular momentum. For the principal groups of the periodic table in which the angular momentum of the atom is carried by either one, two, or three electrons added to or missing from a closed shell the appropriate terms in the expression for the one particle Green's function are identified. The first of the coupled integro-differential equations for the Green's functions is then solved to lowest order in h in the manner indicated by Baraff and Borowitz. The result is a modified Thomas-Fermi model that differs from the previous results of Sessler and Foley for the same problem. The Sessler-Foley modification of the Thomas-Fermi atom is rederived in the spirit of the cranking model for the nucleus by spinning the potential. The present formalism is seen to lead to the Sessler-Foley result in the limit of many particles carrying the angular momentum. However, the region of validity of the cranking model in the nucleus lies far removed from the magic numbers where there are many nucleons outside a spherical core. Thus the Sessler-Foley result may be interpreted as a kind of cranking model of the atom. In contrast to the previous work the present formalism yields a sign change for the quadrupole coupling constant on passing through closed shells and calculated values for the quadrupole coupling constant of the halogens are seen to be within an order of magnitude of the accepted values. (auth)

14933 (EANDC(OR)-19(L)) COLLECTED PROGRESS REPORTS TO EANDC FROM AUSTRIA, GREECE, SWEDEN AND SWITZERLAND. (European Nuclear Energy Agency, Paris). Jan. 1963. 26p.

Information obtained in studies of the nuclear properties of several elements is presented along with data and information on slow neutron scattering. Research on neutron choppers, electromagnetic mass separators, Van de Graaff accelerators, time-of-flight spectrometers, crystal spectrometers, and neutron polarization measurement is also reported. (J.R.D.)

14934 (GA-3330) HIGH-TEMPERATURE VAPOR-FILLED THERMIONIC CONVERTER. Quarterly Technical Progress Report, March 15 through June 30, 1962. R. Skoff (General Atomic Div. General Dynamics Corp., San Diego, Calif.). July 13, 1962. Contract AF33(657)-8563. 14p. (AD-278816)

Research covers the work done on a bench test of an unclad thermionic converter. The objective is to produce an efficient, high-power-density, long-life thermionic power converter using a uranium-zirconium-carbide emitter and a high-temperature nickel collector. (auth)

14935 (GA-3873) CHARGE STATES OF RECOIL ATOMS. Final Report, April 18, 1960–December 31, 1962. V. A. J. van Lint and R. Denson (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Feb. 8, 1963. Contract DA-04-495-ORD-1961. 40p.

Measurements of the charge state of Cu atoms having energies to 50 kev and an average energy of 29 kev, were performed. The recoil atoms were prepared as the result of a (γ,n) reaction in Cu target foils. The recoil atoms which escaped from a surface of the target foil were detected by observing their radioactivity in an adjacent Al catcher foil. The charge state and energy spectrum of the charged recoils were measured by applying various retarding voltages to the catcher foil. The experimental results indicate that approximately 55% of the recoil atoms are charged, and that these charged recoil atoms are found throughout the energy spectrum. (auth)

14936 (IS-623) HIGH PRESSURE RESEARCH AT LOW TEMPERATURES. C. A. Swenson (Ames Lab., Ames, Iowa). [Feb. 22, 1963]. Contract [W-7405-eng-82]. 18p.

The problems of carrying out research at very low temperatures are complicated by the solidification of all pressure transmitting substances at even modest pressures. Data can be obtained only through the use of various modifications to conventional techniques. Probably the most extensive data have been obtained for the effects of pressure on superconducting transition temperatures. Here, liquid and solid helium, solid hydrogen, and even ice have been used as pressure transmitters. Much simpler techniques can be used to obtain pressure-volume-temperature data at low temperatures for the theoretically interesting alkali metals and solidified inert gases. In particular, the differences in the low temperature pressure-volume relations obtained for cesium and for solidified xenon can be interpreted directly in terms of the basic theories of simple metals and molecular solids. Purely quantum-mechanical effects, such as those due to the zero point energy in the solidified inert gases, are observable. (auth)

14937 (LADC-5411) FLOW OF LIQUID He II UNDER LARGE TEMPERATURE AND PRESSURE GRADIENTS. P. P. Craig, W. E. Keller, and E. F. Hammel, Jr. (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract W-7405-eng-36. 53p.

Measurements of heat conduction and fountain pressure for liquid He II flowing through narrow slits ($0.3\mu < d < 3.3\mu$) for temperature differences as large as 1°K have been

previously reported. For the lower, yet appreciable, temperature differences the linear two-fluid equations of London and Zilsel were quantitatively verified; integration over the temperature interval was required. The analysis of the measurements is extended to higher gradients, for which the linear equations are no longer applicable. For this purpose integrated solutions of the Gorter-Mellink nonlinear thermohydrodynamic equations, based on the concept of mutual friction, are derived with special emphasis placed on the assumptions and restrictions necessitated by the model. The integrals for heat flow and fountain pressure have been solved numerically using a high-speed computer, and the results are compared with the experiments. When Vinen's values of the mutual friction parameter A(T) are employed in the solutions, the comparison is quite good, except near the λ-point; it is also shown that other values of A(T) are not compatible with the observations. An explanation in terms of the vortex line model is proposed for the deviations near T_λ. Despite the agreement between the vortex line theory and experiment obtained here, several as yet unresolved difficulties are associated with flow phenomena in small slits; certain aspects of these problems are discussed, most notably the criteria for the onset of the nonlinear dissipation effects. 31 references. (auth)

14938 (LADC-5472) FLUX TRAPPING AND FLUX PUMPING WITH SOLENOIDAL SUPERCONDUCTORS. Henry L. Laquer (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract [W-7405-eng-36]. 15p.

Techniques for determining the properties of superconductors of large cross section are described together with various methods for utilizing these materials for the production of persistent magnetic fields. Critical current densities of some Nb–Sn preparations are included. (auth)

14939 (LNF-62/58) RISULTATI PRELIMINARI DI BOBINE SUPERCONDUTTRICI. (Preliminary Results of Superconducting Coils). Note No. 148. P. de Feo, G. Pasotti, and G. Sacerdoti (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). July 11, 1962. 11p.

In the construction of superconducting magnets, several problems have yet to be resolved. The preliminary results are presented on the study of thermal switches, contacts between superconductor and non-superconductor and between superconductor and superconductor, and construction of coils. The parameters of the coils designed are tabulated. (J.S.R.)

14940 (NASA-TN-D-1686) NOTE ON THE THICKNESS OF THE HELIUM ION LAYER. S. J. Bauer (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.). Mar. 1963. 5p.

On the basis of recent experimental results as well as theoretical considerations of the temperature dependence of the light constituents (hydrogen and helium) in the upper atmosphere, a model of the helium ion belt—the "heliosphere"—is constructed. The thickness of the helium ion layer varies significantly with atmospheric temperature: about 2000 km at 1600°K and only about 200 km at 600°K. Correspondingly, charged particle profiles in the topside ionosphere may show a slope corresponding to He^+ at high temperature, but not at low temperatures when the thickness of the helium ion layer is comparable to or less than the scale height of helium ions. 18 references. (auth)

14941 (NBS-7608) ON THE CRYOGENIC ASPECTS OF PROJECT SHERWOOD. Eleventh Progress Report, July 1–September 30, 1962. (National Bureau of Standards. Boulder Labs., Boulder, Colo.). Sept. 30, 1962. 19p.

Measurements were made of a-c susceptibility on niobium 4 mil wire as a function of temperature at 4 to 9°K. The bulk critical field at 4°K was about 13 kgauss. Magnetization curves were drawn. Using a d-c technique, the susceptibility of a 10 mil niobium wire was measured. The bulk critical field was found to be less than 3 kgauss. Electron tunneling between a normal metal and superconductor was studied. A device for stressing aluminum samples a known amount was developed. An analysis was made of refrigeration cycles. A gas-gearing-supported turbine was developed. (M.C.G.)

14942 (NP-12528) GROUND SHOCK. Suffield Special Publication 12/61. G. H. S. Jones (Canada. Suffield Experimental Station, Ralston, Alberta). Nov. 15, 1962. 9p.

A brief survey of ground shock and cratering effects produced by primarily ground burst TNT charges ranging from 8 lb to 100 tons is given. Seismic effects are also briefly discussed and the need for further investigations in this field is pointed out. (auth)

14943 (NYO-9812) ULTRAHIGH VACUUM TECHNIQUES. Quarterly Progress Report, July 1–September 30, 1962. Research Report 62-828-441-R1. (Westinghouse Electric Corp. Research Labs., Pittsburgh). Oct. 31, 1962. Contract AT(30-1)-2823. 19p.

The use of SiC in conjunction with an electron multiplier was found to offer good possibilities for a cold electron ion gage. A helium cryopump with 50 l/sec pumping speed was developed that is capable of maintaining a static system at pressures below $\sim 5 \times 10^{-11}$ torr with only about one liter of liquid helium every 8 hr. Additional results are reported in photon desorption experiments from tungsten and glass, hydrogen absorption on tungsten, and oxygen adsorption on tungsten. Studies were begun on photon desorption using a field emission microscope and on the interaction of electrons at surfaces. Studies are being continued on the outgassing characteristics of metal systems operating at elevated temperatures. (auth)

14944 (NYO-10088) FABRICATION OF SEMICONDUCTOR DEVICES BY NEUTRON TRANSMUTATION DOPING. Annual Report, December 1961–December 1962. Carl N. Klahr (Fundamental Methods Associates, New York). Dec. 31, 1962. Contract AT(30-1)-2914. 167p.

Progress in the development of fabrication methods for semiconductor devices by neutron transmutation doping is described. Quantitative expressions are given for spatial control of the electronically active impurities (introduced by neutron transmutation) by means of radiation dies. Neutron transmutation reactions in germanium and silicon were surveyed. Required neutron flux levels were calculated. The electronic properties of devices produced by this method were examined. The program is directed toward the design of a proof-of-principle experiment. These results tend to substantiate both the technical and the economic feasibility of radiation die fabrication of appropriate semiconductor devices. (auth)

14945 (NYO-10255) QUANTUM ELECTRODYNAMICS WITHOUT ELECTROMAGNETIC FIELD. I. Bialynicki-Birula (Rochester, N. Y. Univ.). Feb. 6, 1963. Contract AT(30-1)-875. 14p.

A bound state that has all the properties of a neutral vector particle is shown to appear in a non-linear Heisenberg-type theory. From such a model all the results of standard electrodynamics follow in the limit of an infinite bare coupling constant. The method used is that of

Schwinger's external sources. That particles may appear in conventional field theory without corresponding fields being introduced into the initial Lagrangian is demonstrated. (D.C.W.)

14946 (OU-LNS-62-01) [ACTIVITIES OF THE] LABORATORY OF NUCLEAR STUDIES. (Osaka Univ. Lab. of Nuclear Studies). 1962. 12p.

Instrumentation and programs for research in nuclear physics by the cyclotron, betatron, high-voltage accelerator, mass spectroscopy, radioisotope, and theoretical divisions are discussed. (M.C.G.)

14947 (SC-4759(RR)) THE DISTRIBUTION OF ABSORBED X-RAY ENERGY IN THE ATMOSPHERE. Frank Biggs (Sandia Corp., Albuquerque, N. Mex. and Sandia Corp. Livermore [Lab.], Livermore, Calif.). Feb. 1963. Contract [AT(29-1)-789]. 18p.

An approximation was developed for calculating the distribution of absorbed x-ray energy in the upper atmosphere for the following two sources: an isotropic point source above the atmosphere and a plane beam of x rays incident vertically downward on the atmosphere. The approximation neglected earth curvature. This result was then applied to black-body spectra of kT = 0.5 kev, kT = 1.0 kev, kT = 1.5 kev, and kT = 2.0 kev. (auth)

14948 (TID-15615) REMARKS ON THE HEAT TRANSPORT IN HELIUM II AT HIGH FLUX VALUES. Report No. 62-5. T. H. K. Frederking (California. Univ., Los Angeles. Dept. of Engineering). Feb. 1962. Contract AT(11-1)-34. 30p.

A brief discussion of heat transport phenomena in He II at low fluxes precedes examination of heat transport at or near the maximum. The two-fluid model is used in treating subcritical heat flow and frictional and resistance terms are added for the supercritical flow. Solutions for subcritical capillary flow and flow through a slit are compared with experimental results. For the case of the maximum heat flux, nucleate boiling and formation of gaseous films between the heater surface and fluid are examined. Heat convection is explored, and the effects of bubble formation are discussed. Experimental results on nucleate boiling and the formation of He I–He II boundaries are described. Comments on transient operation are included. Maximum flux in He II is noted to be an order of magnitude greater than for He I and the heat transfer coefficient below the lambda point is found to be similar for the two fluids. 38 references. (D.C.W.)

14949 (TID-18035) ENERGIES AND WAVE FUNCTIONS OF THE f^3 CONFIGURATION IN INTERMEDIATE COUPLING. Johns Hopkins Spectroscopic Report No. 19. E. H. Carlson and H. M. Crosswhite (Johns Hopkins Univ., Baltimore). Oct. 1960. Contract AT(30-1)-1447. 26p.

The energies, in terms of the Slater integral F_2, of all levels of the f^3 configuration are given for values from −6.8 to +10.0 of the spin-orbit constant χ expressed also in terms of F_2, as well as the wave functions. For the latter the coefficients in the linear expansion in terms of L, S-coupling functions are given for $\chi = -5.7$, 2.6, and 8.4 that correspond closely to the situation in Er^{3+}, Nd^{3+} and U^{3+}. Energies and wave functions are calculated with the usual simplifying assumptions the chief of which are: (1) No interconfiguration interaction; (2) Hydrogenic wave functions for the ^4f orbits. (auth)

14950 (TID-18039) WALL EFFECTS IN NON-EQUILIBRIUM STATISTICAL MECHANICS. Progress Report No. 1. Henry B. Hollinger (Rensselaer Polytechnic Inst., Troy, N. Y.). Feb. 1963. Contract AT(30-1)-3036. 10p.

The status of work aimed at determining the role of containing walls in the approach to equilibrium of a statistical mechanical model and at determining the effect of wall collisions on transport properties is reported. The effect of wall collisions on the character of trajectories in simple classical dynamical systems and on the time-dependence of wave functions for simple quantum mechanical systems has received some treatment. Effects on the time-dependence of ensemble distribution functions for statistical mechanical models have received the most attention, and a three-form model for dealing with it is discussed. (D.C.W.)

14951 (TID-18050) THE THEORY OF IRREVERSIBLE PROCESSES. G. V. Chester (Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics). Sept. 1962. Contract [AT(30-1)-2179]. 102p.

A survey is given of recent developments in the theory of irreversible processes. Particular emphasis is laid on the derivations of master equations by Van Hove and Prigogine and on the linear response theory initiated by Kubo and Tomita. The emphasis in the presentation is on the assumptions underlying these theories and the physical consequences that follow from them. The ergodic theorems that follow from the master equations are discussed and the basic problem of how irreversibility arises is reviewed in the light of these recent developments. Formal linear response theory is summarized and the recent work on nonequilibrium open systems is discussed in some detail. Some special applications that illustrate the general theories are presented at the end of the article. Several topics have been omitted—there is no discussion of irreversible thermodynamics or other phenomenological theories, and the theory of thermodynamic Green's function is mentioned only briefly. Both these topics are dealt with in detail in books referred to in the 127 references. (auth)

14952 (UCRL-6719-T) DIFFERENCE METHODS AND THE EQUATIONS OF HYDRODYNAMICS. W. F. Noh and M. H. Protter (California. Univ., Livermore. Lawrence Radiation Lab.). [1960]. Contract [W-7405-eng-48]. 60p.

Finite difference approximations for the partial differential equations of hydrodynamics can be found by soft solution methods. Methods for finding soft solutions for the equations of one-dimensional flow with constant pressure are discussed, and the extension to more general cases and more space variables is made. A linear problem is analyzed, the soft solution yielding difference methods. Exact difference methods for nonlinear equations are obtained, and the cases for constant and time-variant pressure are examined. An example of one-dimensional hydrodynamics with an adiabatic gas law shows that these difference equations can also be obtained from soft solutions. (D.C.W.)

14953 (UCRL-10526) MAGNETIC ANALYSIS OF ATOMIC AND MOLECULAR BEAMS. I. CONSTRUCTION AND CALIBRATION OF INHOMOGENEOUS DEFLECTING MAGNETS. Ronald R. Herm and Dudley R. Herschbach (California. Univ., Berkeley. Lawrence Radiation Lab.). Oct. 1962. Contract W-7405-eng-48. 38p.

Three small iron-core electromagnets have been constructed for experiments in magnetic analysis of atomic and molecular beams. The magnets and their characteristics are described, and measurements of their efficiency

by examination of the flux through the air gap and various cross sections of the magnet yoke as a function of the energizing current are made. One magnet displays a peak induction at the gap midpoint of 15 Kgauss with a transverse gradient of 90 Kgauss/cm. Corresponding values for the other two are 10 Kgauss and 30 Kgauss/cm. (D.C.W.)

14954 (UCRL-10562) PERTURBATION-THEORY RULES FOR COMPUTING THE SELF-ENERGY OPERATOR IN QUANTUM STATISTICAL MECHANICS. Gordon Baym and Andrew M. Sessler (California. Univ., Berkeley. Radiation Lab.). Dec. 17, 1962. Contract W-7405-eng-48. 17p.

Highly convenient rules are given for the general term in the time-independent perturbation-theory expansion for the self-energy operator of quantum statistical mechanics. The rules are derived by starting from the usual formalism involving time-independent Green's functions. The well-known formulas for thermodynamic quantities in terms of the self-energy operator are included for completeness. (auth)

14955 MOBILITY OF THE POSITIVE CHARGE IN DENSE IONIZED GASES. Iovițu Popescu (Inst. of Physics, Bucharest). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 13: 449-53(1962). (In Rumanian)

When a very weakly ionized gas is compressed until the mean distance between atoms is reduced to less than ten atomic radii, the positive charge is transported no longer by the atomic residue, but leaks from one atom to the other. This conclusion results from the comparison between the collision frequency of the positive ions and the resonant transfer frequency of the charge. The expression of the mobility and of the effective mass of the positive charge is deduced. (tr-auth)

14956 EFFECT OF IONIZING RADIATIONS ON CRYSTALS. Jules Duchesne and Joseph Depireux (Université, Liege). Acad. Roy. Belg., Classe Sci., Mem., Collection in 8°, 32: 355-63(1961). (In French)

The pure quadrupole spectroscopic method for the study of the effect of ionizing radiation on solids is described. The total characteristic of the method, its sensitivity, and its generality assures its efficiency in the region of solid-state radiochemistry. (J.S.R.)

14957 STRUCTURE OF PLANETARY ATMOSPHERES. S. I. Rasool (National Aeronautics and Space Administration, New York). AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 6-19(Jan. 1963).

The temperature, composition, pressure, and other properties of the atmospheres of Earth, Mars, Venus, and Jupiter are reviewed in the light of the most recent observational results. Several models for the Venus atmosphere are described. (D.L.C.)

14958 MULTIPOLE EXPANSION OF COULOMB ENERGY. B. C. Carlson and G. L. Morley (Ames Lab., Ames, Iowa). Am. J. Phys., 31: 209-11(Mar. 1963).

The electrostatic self-energy of a given charge distribution is expanded in an infinite series, each term of which corresponds to a single term in the multipole expansion of the potential. Several forms of the energy expansion are derived. As an illustrative example, the Coulomb energy of a hemisphere uniformly filled with charge is calculated. (auth)

14959 TENSORIAL FUNCTIONS OF A VECTOR AND THE ELEMENTARY LAWS OF ELECTROMAGNETISM. Giovanni Zin. Ann. Mat. (4), 50: 341-78(1960). (In Italian)

An algorithm particularly adapted for the study of the elementary laws of electromagnetism was reported either for the purpose of establishing the degree of uncertainty by which they are affected or for the purpose of determining all the elementary laws having allotted requirements. The general properties of the elementary laws and their classification are first examined. The tensors of the second and third order associated with the elementary laws are then studied. Such tensors are all functions of a vector and, having properties which modify the new components of the tensor, are expressed as functions of the new components characterizing the vector having formal invariance. Such a property is expressed in a system of functional equations which are resolved. The 9 (27) components of the tensors of the second (or third) order have to be expressed by means of a linear combination of only 3 (or 7) functions of the unique model of the vector called "distance functions" of the tensor. Investigation of the elementary laws having assigned properties gives place to systems of differential equations within the components of the tensors associated with these laws. Such systems sometimes consist of an enormous number of equations with partial derivatives of the first or second order. However, the knowledge of the simple structure of the unknown tensors and an appropriate calculation procedure allow solutions to be attained in a relatively simple manner, with respect to the complexity which the question offers at first glance. Some examples are given as illustrations. Questions relative to the uncertainty of the first Laplacian elementary law are considered extensively. The general expressions of particular aspects of electrodynamic laws are determined. (tr-auth)

14960 STUDY OF THE DISSOCIATION OF H_2^+ AND D_2^+ IONS BY PASSAGE THROUGH GAS. R. Caudano, J. M. Delfosse, and J. Steyaert (Université, Louvain, Belg.). Ann. Soc. Sci. Bruxelles, Ser. I, 76: 127-47(1962). (In French)

A new method is described to measure the energy liberated during the dissociation of a molecular ion. A mass spectrograph measures the impulse received by each particle coming from the molecular ion's break-up. With this method the reactions $H_2^+ \rightarrow H^+ + H^0$ and $D_2^+ \rightarrow D^+ + D^0$ are studied. The H_2^+ and D_2^+ ions have a kinetic energy of 14 kev when they strike a gaseous target of hydrogen or xenon. The energy spectra obtained reveal a maximum at 0 ev owing to dissociations by vibrational transitions and a second one at about 2.6 ev owing to electronic transitions. One remarks on the different spectra that this last maximum extenuates and disappears as a function of the relation: target atom mass/incident ion mass. This fact can be explained by a more and more important violation of the Franck-Condon principle. A survey is given of recent or important experimental investigations on rearrangement collisions between atoms or ions with atoms or molecules from 1 ev to several Mev. 182 references. (auth)

14961 LONGITUDINAL CRITICAL CURRENTS IN COLD-DRAWN SUPERCONDUCTING ALLOYS. S. T. Sekula (Oak Ridge National Lab., Tenn.), R. W. Boom, and C. J. Bergeron. Appl. Phys. Letters, 2: 102-4(Mar. 1, 1963).

Examination of critical currents in Nb–Zr, Mo–Re, and Ta–Ti cold-drawn superconducting wires operating in magnetic fields parallel to the superconducting transport current reveals that maximum longitudinal currents in the Nb–Zr alloys occur at 20 to 30 kgauss, one sample showing a 480 amp current at 25 kgauss. The Mo–Re and Ta–Ti alloys exhibit maximum currents at 5 and 20 kgauss. An attempt at force-free magnet operation results in considerable current loss. (D.C.W.)

14962 HYDROMAGNETIC OSCILLATIONS OF FLUID SPHERE ABOUT THE EQUIPARTITION STATE. Jerome Kristian (Univ. of Chicago). Astrophys. J., 137: 102-16 (Jan. 1963).

The characteristic value problem posed by axisymmetric perturbations of the toroidal equipartition state is attacked by expanding the characteristic function in two sets of orthogonal functions. The secular matrix so derived is symmetric, with even and odd terms separated. The case where the hydromagnetic energy is much less than the gravitational energy is considered separately. It is found that there are two sets of characteristic modes. One is associated with the ordinary hydrodynamic Kelvin modes and has frequencies which are the Kelvin frequencies increased by a term quadratic in the field strengths. The other is a set of pure hydromagnetic modes, with frequencies linear in the field strengths. The latter provides for frequencies much smaller than the Kelvin frequencies for large values of the fields. The work applies to a fluid sphere in magnetic fields, as in magnetic variable stars. (auth)

14963 PERTURBATIONS OF THE EQUIPARTITION STATE IN HYDROMAGNETICS: THE TENSOR VIRIAL APPROXIMATION. Jerome Kristian (Univ. of Chicago). Astrophys. J., 137: 117-24(Jan. 1963).

The general problem of perturbations of the equipartition state is discussed, using the tensor virial approximation. The non-static equilibrium state leads to two additional terms in the characteristic value equation, one expressed by means of a vector field whose field lines move with the unperturbed fluid. The characteristic value problem is solved for the toroidal equilibrium state. It is found that the degeneracy of the Kelvin modes is lifted by the field; the Kelvin frequencies are corrected by terms linear in the field strengths, with equally spaced levels for small fields. (auth)

14964 NOTE ON THERMAL RADIO RADIATION. Ludwig Oster (Yale Univ., New Haven). Astrophys. J., 137: 332-7(Jan. 1963).

Inaccuracy in the transition region of the velocity limited expression for average emission of a single electron with certain characteristics leads to calculations to determine the extent of error. The quantum limit and the emission coefficient are determined, and the transition from the classical to the quantum approximation and its dependence on the charge number Z are shown. Classical and quantum approximations have the same frequency dependence, and the relative size of the numerical correction increases with frequency. (D.C.W.)

14965 ANALYTIC FUNDAMENTALS OF THE THEORY OF ELECTROMAGNETIC FIELDS. Giovanni Zin. Atti Accad. Sci. Torino. I. Classe Sci. Fis., Mat. Nat., 94: 719-25(1959-60). (In Italian)

A study is made to substitute the Maxwell equations, which control the behavior of the electromagnetic field at every point of a region, with integral equations concerned with only the contour of the region itself. (tr-auth)

14966 CURVATURE OF THE RIEMANN METRICS OF THE PLANE THREE-BODY PROBLEM. André Deprit and André Delie (Institut de Mathématiques, Louvain, Belg.). Bull. Classe Sci., Acad. Roy. Belg., (5) 48: 652-8(1962). (In French)

The plane three-body problem, as it is reduced by F. D. Murnaghan, introduces Riemann metrics in the kinetic energy. The curvature tensor or the Riemann-Christoffel tensor is calculated from which the Ricci tensor and the scalar Riemann curvature was derived. With a numerical factor, this curvature is proportional to the inverse of the polar moment of inertia of three point masses. (tr-auth)

14967 THE MÖSSBAUER EFFECT. Andrè Gerard (Université, Liege). Bull. Soc. Belge Phys., No. 10, 619-28 (1961). (In French)

The basic principles of the Mössbauer effect are reviewed, and the application of this effect to the study of nuclear physics, solid-state physics, and relativity is described. (J.S.R.)

14968 MONTE CARLO CALCULATIONS OF THE RANGES OF ENERGETIC ATOMS IN SOLIDS. Mark T. Robinson, D. K. Holmes, and O. S. Oen (Oak Ridge National Lab., Tenn.). Colloq. Intern. Centre Natl. Rech. Sci. (Bellevue, France), 1962: No. 113, 105-17(1962). (In English)

The slowing down of energetic atoms in solids was investigated through the use of Monte Carlo methods on a large digital computer. Neither the hard sphere approximation nor the inverse square approximation affords a particularly satisfactory account of the exponentially screened Coulomb potential. It is found for Cu, Ag, and Au, slowing down in their respective solids, that the screening radii must be respectively 1.15, 1.6, and 2.3 times greater than the values proposed by Bohr, in order to explain the available experimental data. It is apparent from the results of these calculations that modifications of the interatomic potential functions must be sought, especially for heavier elements. (auth)

14969 DISPERSION EFFECTS BOUND TO THE ABSORPTION OF RESONATING FLUORESCENCE OF ATOMIC NUCLEI. Alfred Kastler (Laboratoire de Physique de l'École Normale Supérieure, Paris). Compt. Rend., 255: 3397-9(Dec. 17, 1962). (In French)

It is shown that the use of dispersive media of high optical density should permit the observation of the effects of birefringence and of magnetic rotative polarization connected to resonating absorption. (tr-auth)

14970 NEW METHOD FOR THE CALCULATION OF ATTENUATION FACTORS BY ELECTRON COLLISIONS. Sylvie Brechot and Henri Van Regemorter (Observatoire de Meudon, France). Compt. Rend., 256: 609-11(Jan. 14, 1963). (In French)

The Baranger theory is modified by the Seaton and Burgess semi-classical techniques for the calculation of collision cross sections. The method is applied to the calculation of the lengths of the D_1 and D_2 rays of sodium and the H and K rays of ionized calcium. (tr-auth)

14971 CALCULATION OF MULTIPLE SCATTERING BY MEANS OF SECOND DIFFERENCE SUMS OF DEFLECTIONS MEASURED ON TRAJECTORIES IN NUCLEAR EMULSIONS. Tsai-Chü, Jeannine Fitan, and Denise Schune-Boisble (Faculté des Sciences, Paris). Compt. Rend., 256: 649-51(Jan. 14, 1963). (In French)

The method of two second difference sums was studied and compared with the usual method by means of more than 5000 cellules on electron tracks. (tr-auth)

19472 THE VALIDITY OF THE APPROXIMATION SOLUTIONS OF THE SCHROEDINGER EQUATION AND THE ACCURACY OF THE EXPECTED VALUE AND TRANSITION ELEMENTS. H. Preuss. Fortschr. Physik, 10: 271-320(1962). (In German)

A survey is given on the various basic methods for the approximate solution of the Schroedinger equations. The possibilities of finding data on the deviation of the theoretical results from the exact results are considered in some detail. 109 references. (J.S.R.)

14973 GENERAL RELATION OF FUNDAMENTAL MOLECULAR CONSTANTS BETWEEN TWO ELECTRONIC STATES. Joseph C. Y. Chen (Brookhaven National Lab., Upton, N. Y.). J. Chem. Phys., 38: 832-6(Feb. 15, 1963). (BNL-6403)

The general relation of fundamental molecular constants between electronic states is investigated in some detail. Formulas stating such relations are found, and the interaction matrix elements, which relate the corresponding electronic states, are examined. Calculations of the quadratic, cubic, and quartic force constants for the hydrogen molecule ion H_2^+ are carried out, as an example, by utilizing these formulas. The calculated values agree very satisfactorily with those obtained from spectroscopic data. (auth)

14974 OXYGEN-17 NMR SHIFTS CAUSED BY Cr^{++} IN AQUEOUS SOLUTIONS. Jasper A. Jackson, Joe F. Lemons, and Henry Taube (Los Alamos Scientific Lab., N. Mex.). J. Chem. Phys., 38: 836-9(Feb. 15, 1963). (LADC-5404)

Cr^{2+} in solution produces a paramagnetic shift in the NMR absorption of O^{17} in ClO_4^-, as well as the expected paramagnetic shift for O^{17} in H_2O. As the concentration of ClO_4^- increases, the shift in the H_2O^{17} absorption is diminished and eventually changes sign. The effects are ascribed to preferential replacement by ClO_4^- of water molecules from the axial positions in the first coordination sphere about Cr^{2+}. (auth)

14975 ANALYSIS OF THE SPECTRA OF TRIPOSITIVE PRASEODYMIUM IN ETHYLSULFATE CRYSTALS. John B. Gruber (Univ. of California, Los Angeles). J. Chem. Phys., 38: 946-50(Feb. 15, 1963).

A theoretical calculation is presented for the "free-ion" spectrum of Pr^{3+} ($4f^2$). A least-squares calculation is made to obtain a set of Slater and spin-orbit parameters that gives a theoretical spectrum in closest possible agreement with the observed absorption spectrum of Pr^{3+} ($4f^2$) in ethylsulfate crystals. The disagreement between the calculated and observed spectrum may be explained as due primarily to the neglect of the configuration interaction in the "free-ion" calculation, and to a much smaller extent as due to the effect of the lattice environment surrounding the $Pr^{3+}(4f^2)$ ion. In comparing the spectrum of $Pr^{3+}(4f^2)$ in ethylsulfate crystals with the spectrum of the same ion in other crystals, the shift in energy of the J levels may be explained as due to the difference in chemical bonding in the various crystals. This "chemical bonding" shift may be accounted for by a simple change in the Slater and spin-orbit parameters. Assuming that the local symmetry about the Pr^{3+} ($4f^2$) ion is D_{3h}, a first-order perturbation calculation is carried out for the crystal-field split components of the Pr^{3+} ($4f^2$) ion J-levels, $^3P_2$, $^1I_6$, $^3P_1$, $^3P_0$, $^1D_2$, $^1G_4$, $^3F_4$, $^1F_3$, and $^3H_4$. The following set of lattice parameters, $A_n^m(r^n)$, obtained by a least-squares calculation, gives the best over-all agreement between the theoretical and observed spectrum: $A_2^0(r^2) = 16.32$ cm^{-1}, $A_4^0(r^4) = -83.46$ cm^{-1}, $A_6^0(r^6) = -45.76$ cm^{-1}, and $A_6^6(r^6) = 530.21$ cm^{-1}. A more complete calculation is then made using an IBM 7090 program that diagonalizes the entire intermediate-coupling and D_{3h} crystal-field-splitting matrix. Again, from a least-squares calculation, the following "best" set of parameters is found: $F_2 = 307.4$ cm^{-1}, $F_4 = 49.44$ cm^{-1}, $F_6 = 5.138$ cm^{-1}, $\zeta = 727.9$ cm^{-1}, $A_2^0(r^2) = 15.31$ cm^{-1}, $A_4^0(r^4) = -88.32$ cm^{-1}, $A_6^0(r^6) = -48.76$ cm^{-1}, and $A_6^6(r^6) = 548.48$ cm^{-1}. When one compares the theoretical energy spectrum based on these parameters with the observed spectrum, one finds an average deviation of 3.0 cm^{-1} and a standard deviation of only 1.0 cm^{-1}. (auth)

14976 CONFIGURATION INTERACTION OF THE Pr^{3+} ION. Eugene Y. Wong (Univ. of California, Los Angeles). J. Chem. Phys., 38: 976-8(Feb. 15, 1963).

The electrostatic interaction between $4f^2$ and $5d^2$ was calculated from the wavefunctions with Slater integrals $G_1 = 492$ cm^{-1}, $G_3 = 44.5$ cm^{-1}, and $G_5 = 2.94$ cm^{-1}. When this configuration interaction was taken into account the calculated spectrum of Pr^{3+} was in better agreement with the experimental data. (auth)

14977 ELASTIC SCATTERING OF LOW-ENERGY ELECTRONS AND THE PERIODIC SYSTEM OF ELEMENTS. T. Tietz (Univ. of Lódź, Poland). J. Chem. Phys., 38: 1027-8(Feb. 15, 1963).

A brief study was made of the elastic scattering properties of the Thomas-Fermi atom for low-energy electrons. A radial Schrödinger equation was used to obtain analytical formula for the cross section. The total cross section is calculated to be $Q_0 = 4\pi/[k^2 + (-1/a + 1/2r_0k^2)^2]$, which becomes $4\pi a^2$ for zero energy. The scattering length is calculated to be $a = 2\pi\ Z/A \cos[\pi/2(1 + 8Z/A)^{1/2}]$. It is concluded that the Ramsauer-Townsend effect will appear for those Z for which the absolute value of a is the greatest, and that the cross section energy curve will be periodic. (D.L.C.)

14978 NUMERICAL COMPUTATION OF THE TEMPORAL DEVELOPMENT OF CURRENTS IN A GAS DISCHARGE TUBE. W. Boersch-Supan and H. Oser (Technische Hochschule, Darmstadt, Ger.). J. Res. Natl. Bur. Std., 67B: 41-60(Jan.-Mar. 1963).

The behavior of electrical currents in a gas discharge tube including space charge effects is investigated by numerical integration of the governing nonlinear partial differential equations. Both stationary solutions and the temporal development, under the influence of space charge effects, are considered. It is found that the truncation error can be greatly reduced by comparison with formal solutions for constant fields. The discussion is essentially restricted to the more mathematical questions. (auth)

14979 ANION EFFECTS ON THE Pr^{3+} SPECTRUM. Ralph D. McLaughlin and John G. Conway (Univ. of California, Berkeley). J. Chem. Phys., 38: 1037-8(Feb. 15, 1963). (UCRL-10458)

Shifts in spectral lines of Pr^{3+} which result from changing the cation-anion distance were studied. Spectra were measured of a few percent Pr^{3+} incorporated into the anhydrous trichlorides of Ce, Nd, Sm, Gd, the anhydrous tribromides of La and Ce, and the ethylsulfates of Ce and Gd. Two types of shifts occur; the main shift, due to the change in position of the center of gravity of the crystal-field states, is consistent with Jorgensen's theory. It is found that the bromide ion expands the rare-earth wavefunction more effectively than the chloride ion, and that the ethylsulfate ion has practically no effect on the Pr^{3+} spectrum. (D.L.C.)

14980 LITHIUM EMISSION IN TWILIGHT AT UPPSALA DURING NOVEMBER 1962. W. Stoffregen, H. Derblom, and B. Ånger (Research Inst. of National Defence, Uppsala). Nature, 197: 783-5(Feb. 23, 1963).

A strong emission of Li occurred suddenly in the evening twilight at 6708 Å on Nov. 7, 1962 at Uppsala. The Li emission was recorded on a patrol spectrophotometer. Observations during Nov. 1962 gave a clear picture of the Li : Na ratio with time. Analysis of the records led to the

conclusion that the Li emission was related to the U.S.S.R. nuclear explosions. (C.H.)

14981 EFFECT OF NAPHTHALENE ON THE QUENCHING OF LIQUID SCINTILLATION SOLUTIONS. Horace E. Dobbs (Wantage Research Lab., Berks, Eng.). Nature, 197: 788(Feb. 23, 1963).

The addition of naphthalene to a liquid scintillator containing benzoic acid was found to result in counting efficiency at low concentrations of benzoic acid and a decrease in efficiency at high concentrations. The addition of naphthalene to a benzoate-quenched solution resulted in a considerable increase in counting efficiency at all quencher concentrations. These results indicate that the quenching effects of benzoic acid and methyl benzoate are basically different. Possible explanations are discussed. (C.H.)

14982 ELECTRON SCATTERING EXPERIMENTS USING AN INTERMEDIATE IMAGE BETA-RAY SPECTROMETER. C.-J. Andreen (Chalmers Univ. of Tech., Gothenburg, Sweden). Nucl. Instr. Methods, 17: 321-4 (Dec. 1962). (In English)

Results are reported for measurements on electron scattering, carried out by means of an intermediate-image beta spectrometer. Most-probable energy losses are given for incident electron energies from 20 to 100 kev using Al, Cu, Ag, and Pb scatterers. The diffuse backscattering coefficient is given as a function of Z, including the whole energy range for the beta spectrum of Sm^{153}, and the results are collected in an empirical formula. The results agree with measurements performed with other experimental arrangements. It is shown that this type of beta spectrometer is suited for these kinds of measurements, and not only in the application of pure beta spectroscopy. (auth)

14983 IONIC CURRENTS IN β-IRRADIATED LIQUID HELIUM II. F. S. Gaeta (Università, Padua). Nuovo Cimento (10), 26: 1173-81(Dec. 16, 1962). (In English)

Experimental results obtained with a simple apparatus, consisting of two plane electrodes facing each other, immersed in He II, and Pm^{147} as ionizing agent are presented. The results suggest that once the ions acquire enough speed in the applied inter-electrodic field, their behavior becomes different from that of the slow ions and the probability of recombination decreases. The transition between the two states seems to be rather sudden, and the transition points fall at the same field intensities and temperatures where Careri, Cunsolo, and Mazzoldi find the variation of ionic mobility. (auth)

14984 COULOMB INTERACTION IN QUANTUM ELECTRODYNAMICS. P. Rastall (Univ. of British Columbia, Vancouver). Nuovo Cimento (10), 26: 1325-7(Dec. 16, 1962). (In English)

The technique of a previous paper (gage transformation followed by unitary transformation) is used to derive the Coulomb interaction form of quantum electrodynamics, in which the interaction hamiltonian consists of a term involving the transverse radiation field, and a term which represents the Coulomb energy of the electrons. As before, the metric of the Hilbert space is definite, and no subsidiary condition is imposed on the state vectors. (auth)

14985 TRANSFORMATIONS OF THE SCHRÖDINGER EQUATION WITH DISCRETE ENERGY SPECTRUM. F. Goded (Escuela Téchnica Superior de Ingenieros de Caminos, Madrid). Nuovo Cimento (10), 26: 1346-53 (Dec. 16, 1962). (In English)

Two methods are presented that permit the derivation, in some rather special cases, one eigenequation, its eigenvalues and corresponding eigenfunctions starting from another eigenvalue problem that is supposed to be already solved. If both methods are applied to a given Schrödinger equation, two new Schrödinger equations are derived. The first method changes both the potential and the energy spectrum, while the second method changes only the potential. The combined use of both methods permits the solution of a small group of quantum mechanical problems to be derived starting from the solutions of the one-dimensional harmonic oscillator and the hydrogen-like atom. Some possible physical applications of the above results are indicated on the third section of the paper. (auth)

14986 THE CONNECTION BETWEEN R-STRUCTURE AND T-STRUCTURE. G. C. Wraith (Cambridge Univ., Eng.). Nuovo Cimento (10), 27: 561-74(Feb. 1, 1963). (In English)

To every T-type diagram in axiomatic field theory there corresponds a set of r-type diagrams, which have support properties in momentum and configuration-space that are preserved under composition of diagrams, and which have the same combinatorial structure as the corresponding T-type diagram. (auth)

14987 SCHWARZSCHILD FIELD IN N DIMENSIONS AND THE DIMENSIONALITY OF SPACE PROBLEM. F. R. Tangherlini (Duke Univ., Durham, N. C.). Nuovo Cimento (10), 27: 636-51(Feb. 1, 1963). (In English)

The fact that laws of physics admit a formal extension to spaces of an arbitrary number of dimensions suggests that there must be some principle (or principles) operative which in conjunction with these laws entails the observed specificity of spatial dimensionality, $n = 3$. Generalizing from an approach on the Newtonian Keplerian problem in n dimensions, it is proposed that this principle may be tentatively summarized in the postulate that there shall be stable bound orbits or "states" for the equations of motion governing the interaction of bodies (considered as "material points"). This postulate is applied to the geodesic equations of motion obtained from a generalization of the Schwarzschild field to static systems with hyper-spherical symmetry, and it is shown that the bound-state postulate uniquely entails the spatial dimensionality. This result is not entirely peculiar to general relativity because it also holds for Newtonian theory if an asymptotic condition is also introduced to exclude cases $n < 3$. The Schrödinger hydrogen atom in n dimensions is also briefly considered for which the postulate also excludes $n > 3$, in conjunction with the asymptotic condition $n < 3$. An attempt is made to understand the logical origin of this postulate, and it is argued that if the basic representatives of a dynamics with a metric are assumed to be material points, such a postulate is needed to construct Einstein's "practically rigid rods," since point bodies in themselves do not provide a measure of distance. Some qualitative applications of these ideas are made to quantum electrodynamics. (auth)

14988 THE LIMITING CURRENT PHENOMENON IN THE PRESENCE OF AN AZIMUTHAL MAGNETIC FIELD. J. E. Allen, A. Boschi, and F. Magistrelli (Euratom-CNEN, Frascati, Italy). Nuovo Cimento (10), 27: 674-92(Feb. 1, 1963). (In English)

Calculations are made that refer to the effect of an azimuthal magnetic field on the limiting current in the low-pressure mercury arc. Measurements of the limiting current are made using two discharge tubes, one of which contains a wire situated at the axis so that an azimuthal magnetic field can be applied. The observed effect of the magnetic field is in agreement with the theory. The actual

value of the limiting current lies below the theoretical value in the case of the tube with the central wire, and a possible mechanism is suggested for this discrepancy. (auth)

14989 PAIR CORRELATIONS IN THE Be ATOM. L. Szasz (Massachusetts Inst. of Tech., Cambridge). Phys. Letters, 3: 263-4(Feb. 1, 1963). (In English)

A general theory of electronic correlation in atoms was used with various combinations of one-electron spin-orbitals and correlation factors to investigate the ground state energies of Be atoms. Fock and Petrashen spin-orbitals and the James-Coolidge correlation factor gave results that agree well with experimental results. (D.C.W.)

14990 CONDUCTION ELECTRON SPIN RESONANCE IN LIQUID LITHIUM. J. N. Titman, J. E. Enderby, and G. D. Wignall (Univ. of Sheffield, Eng.). Phys. Letters, 3: 283(Feb. 1, 1963). (In English)

A marginal oscillator technique was used to obtain the conduction electron spin resonance in liquid lithium at a frequency of 9.5 Mc/s in a low field from Helmholtz coils. (D.C.W.)

14991 THE FERMI SURFACE OF BERYLLIUM. B. R. Watts (Royal Society Mond Lab., Cambridge, Eng.). Phys. Letters, 3: 284-5(Feb. 1, 1963). (In English)

The Fermi surface, determined by using the pulsed high-field method to study the De Haas-Van Alphen effect, in single crystals of Be is discussed and compared to calculated surfaces. (D.C.W.)

14992 THE EFFECT OF SPIN-PHONON INTERACTIONS ON THE THERMAL CONDUCTIVITY OF LANTHANUM COBALT NITRATE. R. Berman, J. C. F. Brock, and D. J. Huntley (Clarendon Lab., Oxford). Phys. Letters, 3: 310-12(Feb. 1, 1963). (In English)

The thermal conductivity of $La_2Co_3(NO_3)_{12} \cdot 24H_2O$ is observed as a function of applied magnetic field and of the angle of application of the field. The changes in conductivity are explained in terms of phonon scattering by a spin system and by ions. (D.C.W.)

14993 MÖSSBAUER EFFECT IN BIOTITE. H. Pollak, M. de Coster, and S. Amelinckx (Departement Fysika Vaste Stof Studiecentrum voor Kernenergie, Mol, Belgium). Phys. Status Solidi, 2: 1653-9(1962). (In English)

Studies are made of Mössbauer absorption of Fe^{57} in biotite. The asymmetric double peak spectrum is explained by quadrupole splitting; the energy levels are influenced by the presence of OH groups in the octahedral surrounding of the Fe ions. (auth)

14994 REGULARIZED MODELS IN ELECTRODYNAMICS. H. J. Groenewold (Rijksuniversiteit, Groningen, Netherlands). Physica, 28: 1265-93(Dec. 1962). (In English)

Models are discussed for regularizing malignant divergencies in classical and quantum electrodynamics. The regularization is performed on the line propagators and/or vertex operators from which the composite propagators are built up. The regularization may be expressed in terms of auxiliary "masses" m or "whiles" a. The degree of regularization with one or more a's is infinite. The regularized models still permit a field concept. The models may be generalized to other types of renormalizable or non-renormalizable theories, provided the perturbation expansion makes sense. (auth)

14995 ACTION PRINCIPLE FOR CLASSICAL FIELDS. F. J. Sancho (Escuela Peritos Industriales, San Sebastián, Spain). Physica, 28: 1324-8(Dec. 1962). (In English)

An action principle for discrete systems is extended to classical field theory. (auth)

14996 THE EVOLUTION TO QUANTUM STATISTICAL EQUILIBRIUM FOR A SIMPLE MODEL. THE STRONG COUPLING LIMIT. A. Janner (Institut Battelle, Geneva), L. Van Hove, and E. Verboven. Physica, 28: 1341-60(Dec. 1962). (In English)

The evolution in time of a dissipative quantum many-body system is considered for an electron interacting with randomly distributed, static, elastic scattering centers. The simplified model is extended to include the interference term and is shown to be consistent with the requirements of the theory to general order in the perturbation. The time variation of the transition probability and of the interference term is studied for all times in the strong coupling limit. In this limit, the approach to statistical equilibrium is characterized by slowly damped oscillations. The calculation is performed analytically up to a last numerical integration carried out by computer. (auth)

14997 THE β- AND γ-BAND SYSTEMS OF ^{14}NS AND ^{15}NS. N. A. Narasimham and K. Strikameswaran (Atomic Energy Establishment, Trombay, India). Proc. Indian Acad. Sci., Sect. A, 56: 316-24(Dec. 1962). (In English)

The spectra of $N^{14}S$ and $N^{15}S$ molecules are obtained in a 2450 Mc/sec microwave oscillator discharge. Vibrational assignments of the β- and γ-systems are studied in more detail. Several hitherto unrecorded bands are satisfactorily explained as belonging to higher ν', ν'' levels in the Deslandres schemes of both β- and γ-systems. The observed isotope shifts ($N^{14}S - N^{15}S$) provide confirmatory evidence for the proposed vibrational analysis. In the case of the γ-system, the $\nu' = 2$ level of the upper state appears to be strongly perturbed showing a shift of about 38 cm^{-1} from the expected position. In the β-system, the isotopic shifts in the band-heads involving the $\nu' = 0$ and 1 levels of the $^2\Delta_{\frac{3}{2}}$ of the upper state show small deviations from expected values. The reality of these small deviations is established beyond doubt by the occurrence of the effect on the 0–0 sub-band which exhibits the isotopic head in a wavelength direction opposite to the expected one. (auth)

14998 A NEW $^2\Sigma - X^2\pi$ SYSTEM IN THE SPECTRUM OF NS. N. A. Narasimham and K. Srikameswaran (Atomic Energy Establishment, Trombay, India). Proc. Indian Acad. Sci., Sect. A, 56: 325-8(Dec. 1962). (In English)

The spectra of $N^{14}S$ and $N^{15}S$ are excited in a microwave, 2450 Mc/sec, discharge. Isotope shifts observed for four bands attributed by Barrow et al. to a $B^2\Pi - X^2\Pi$ system are not in agreement with their vibrational assignment. Experimental evidence for alternate assignments for two of them is presented. The remaining two along with six other sub-band heads could be grouped into a new system involving a transition from a $^2\Sigma$ to the ground $^2\Pi$ state. The doublet separations of the sub-band heads and the $\Delta G_{\frac{1}{2}}$ values of the final level are in agreement with those of the $^2\Pi$ ground state of the NS molecule. The observed isotope displacements support the proposed analysis and enable one to derive an approximate value for W_e' as 1160 cm^{-1}. (auth)

14999 SOME ELECTROMAGNETIC FIELDS OF CYLINDRICAL SYMMETRY. Markandeya Misra and L. Radhakrishna (Banaras Hindu Univ., India). Proc. Natl. Inst. Sci. India, Pt. A, 28: 632-45(July 26, 1962).

The non-static cylindrically symmetric metric of Einstein and Rosen is considered and several exact solutions of the Einstein-Maxwell field equations in vacuo are obtained, some of which represent null electromagnetic fields.

It is found that the metric in case of the null electromagnetic fields is plane symmetric in a sense, and consequently the corresponding solutions represent plane electromagnetic waves. A method is obtained which enables solutions to be constructed, under certain conditions, which represent electromagnetic fields in vacuo from known solutions of the empty space-time field equations and vice versa. Certain results, similar to those obtained in the static axially symmetric case, are also obtained. (auth)

15000 PHOTON FLUID MODELS IN RELATIVISTIC COSMOLOGY. S. N. Pandey (Banaras Hindu Univ., India). Proc. Natl. Inst. Sci. India, Pt. A, 28: 646-54(July 26, 1962).

A Riemannian metric is shown, in a sense, to describe a fluid distribution of photons. The local differential structure of such fields is discussed by examining the nature of certain invariants. The global view of the model is considered by imbedding it in an enveloping flat space of higher dimensions. A metric form for the expanding universe model of relativistic cosmology is deduced, and it is shown how a transition from a material to a photon fluid distribution can take place through abrupt changes in the metrical as well as topological structure of the space-time continuum. A similar transition is demonstrated in the case of a non-null uniform electromagnetic field. The cosmological significance of the photon fluid models is discussed. (auth)

15001 ULTRASONIC ATTENUATION IN LEAD. A. R. Mackintosh (Cambridge Univ., Eng.). Proc. Roy. Soc. (London), Ser. A, 271: 88-104(1963). (IS-436)

The absorption of longitudinal ultrasonic waves was studied as a function of transverse magnetic field in pure single crystals of lead at 1.2°K. The results were found to be generally consistent with the Fermi surface of lead suggested by Gold. In particular a detailed study of the magneto-acoustic oscillations, as a function of sample orientation and field direction, allowed the determination of some of the dimensions of the hole surface in the second Brillouin zone and revealed a number of new electronic orbits on the multiply-connected surface in the third zone. The absolute magnitude of the attenuation and its dependence on propagation direction and on magnetic field were studied and the results interpreted in terms of the general theory of ultrasonic absorption. (auth)

15002 THEORY OF SPIN-ORBIT COUPLING IN ATOMS. II. COMPARISON OF THEORY WITH EXPERIMENT. M. Blume and R. E. Watson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Roy. Soc. (London), Ser. A, 271: 565-78(Feb. 12, 1963).

Results of calculations of the spin-orbit coupling constant for 2p, 3p, 4p, and 3d shell ions and atoms are presented. The calculations are based on a theory developed in a previous paper. Excellent agreement of this theory with experiment is obtained for the 2p and 3d shell ions, while calculations using the familiar $(\partial V/r\partial r)$ expression for the coupling constant lie 10 to 20% too high. The exchange terms discussed in the earlier paper make a contribution to the coupling constant of the same sign and order of magnitude as the ordinary shielding terms. For the 3p and 4p shell atoms, the calculated coupling constants based on the exact theory and on the $(\partial V/r\partial r)$ expression both tend to lie below the experimental values. An explanation for this disagreement is suggested, based on the noded nature of the outer-electron radial wave functions for these atoms. The importance of the residual-spin–other-orbit interaction is discussed, and it is shown that ignoring the form of this interaction may lead to a large variation in the coupling constant within a configuration. (auth)

15003 ELASTICITY IN GENERAL RELATIVITY. C. B. Rayner (Univ. of Liverpool). Proc. Roy. Soc. (London), Ser. A, 272: 44-53(Feb. 19, 1963).

A theory of elasticity is developed in general relativity. In the theory, stress is related to strain by a formula analogous to Hooke's law. Special features of the theory are: with any elastic body motion there is a uniquely associated rigid motion (in the Born sense), which plays a role analogous to that of the rigid body in the ordinary elasticity theory; the 4-velocity of matter is an eigenvector of the Einstein tensor; at each point of an elastic body there are at most 21 independent elastic coefficients; the differential equations of motion of an elastic body are of the second order; and shock waves travel with the same speeds as occur in ordinary elasticity theory. In the theory, consistent use is made of Lie derivatives. (auth)

15004 GENERAL RELATIVITY IN EUCLIDEAN TERMS. R. d'E. Atkinson (Royal Greenwich Observatory, Herstmonceux, Eng.). Proc. Roy. Soc. (London), Ser. A, 272: 60-78(Feb. 19, 1963).

The relativistic equations for the deflection of light, the motion of a particle, and the red shift of spectral lines, in the neighborhood of a single stationary mass, are rigorously derived on the basis of a strictly Euclidean space and an independent time. Only two ad hoc assumptions are needed, in addition to two very obvious extensions of the special theory; one of these assumptions is familiar, but the other, involving the mass of a stationary test particle, is believed to be new. The particle equations are derived from a Lagrangian. Expressions for the kinetic and potential energies are also readily obtained. It is shown that matter with an infinite Young's modulus cannot exist, and the fact that actual measuring rods may therefore be affected by tidal forces, even when they are "unconstrained," is considered. It is shown that in principle observations in the solar system should be made in a time system which is not that in which the clocks of distant observatories are synchronized at present; the difference is below the errors of the best time signals, but not very much below. A rigorous expression is derived for the numerical value of the radial co-ordinate r, in terms of quantities directly observable by the crew of a space-ship (of negligible mass) moving in a circular orbit at the appropriate circular velocity. (auth)

15005 THE CONCEPTUAL STRUCTURE OF PHYSICS. Laszlo Tisza (Massachusetts Inst. of Tech., Cambridge). Rev. Mod. Phys., 35: 151-85(Jan. 1963).

A new technique of logical analysis aimed at bringing about a more harmonious relation between conceptual thinking and formal developments is described. This will provide a foundation spanning classical and quantum mechanics. (D.C.W.)

15006 THE SIGNIFICANCE OF COMPRESSION SHOCKS IN THE PRODUCTION OF INTENSE MOLECULAR BEAMS WITH NOZZLES. Konrad Bier and Otto-Friedrich Hagena (Kernforschungszentrum, Karlsruhe, Ger. and Technische Hochschule, Karlsruhe). Z. Angew. Phys., 14: 658-64(Nov. 1962). (In German)

In the production of intensive molecular beams using nozzles, compression shocks must be avoided as much as possible since they cause a broadening of the velocity distribution and a reduction of the particle current density of the molecular beam. The conditions for the occurrence and the effect of such compression shocks was investigated by measurement of the velocity distribution and the beam intensity for the case when a convergent nozzle is used for the beam production. It was shown that under given condi-

tions a strong compression shock connected with the collision system of the freely expanding gas beam occurs. This compression reduces the beam intensity in single-molecule beams by an order of magnitude and in condensed beams by two orders of magnitude. When this strong compression shock released from the first beam stop is avoided by a suitable selection of the research conditions, weak compression shocks emanating from the peeler can still occur. Possible reduction of this weak compression shock is discussed. (tr-auth)

15007 THE ANALYSIS OF NUCLEAR RESONANCE SPECTRA. J. S. Waugh (Massachusetts Inst. of Tech., Cambridge, Mass.). p. 160-74 of "Advances in Molecular Spectroscopy." New York, Pergamon Press, 1962.

A treatment is presented of the determination of characteristic chemical shifts in nuclear magnetic resonance spectra. The various methods for solving the Hamiltonian are described. The use of magnetic and symmetric equivalence to simplify the solution is discussed. Complicated cases are considered. (D.L.C.)

15008 NEUTRONS IN METEORITES. P. Eberhardt (Universität, Bern), J. Geiss, and H. Lutz. p.143-68 of "Earth Science and Meteoritics." Amsterdam, North Holland Publishing Co., 1963. (In English)

The production, slowing down, and absorption of neutrons in meteorites are discussed and the problem is solved for spherical meteorites. The activities produced by (n,γ)-reactions are calculated. Some approximations for these production rates are derived. The isotopes produced by low energy neutrons show a quite different size dependence than spallation produced isotopes. In optimum sized meteorites, Cl^{36}, Ni^{59}, and Co^{60} are produced much more abundantly from (n,γ)-reactions than from direct spallation. In the center of a chondrite of 75 cm radius the neutron-induced activities of Cl^{36}, Ni^{59}, and Co^{60} would be about 19,280, and 300 dpm/kg respectively whereas by spallation only about 5, 7, and 2 dpm/kg would be made. The minimum size of the meteorite can be estimated from these isotopes, the method being most sensitive in the range of 30 to 70 cm radius. Measured activities lead to sizes which are in agreement with other size-estimates. Neutron-produced stable isotopes, such as Ar^{36}, offer a possibility to decide whether the radiation ages of chondrites are governed by space erosion or not. The available experimental data, although not yet decisive, appear not to support the space erosion theory. (auth)

15009 ENGINEERING ASPECTS OF MAGNETOHYDRODYNAMICS. Proceedings of the Second Symposium on the Engineering Aspects of Magnetohydrodynamics, Philadelphia, Pennsylvania, March 9 and 10, 1961. Clifford Mannal and Norman W. Mather, eds. New York, Columbia University Press, 1962. 586p. $13.50.

Thirty-three papers are included; separate abstracts have been prepared for 30. Three papers were previously abstracted in NSA. (T.F.H.)

15010 A MAGNETIC ANNULAR ARC. W. E. Powers and R. M. Patrick (Avco-Everett Research Lab., Everett, Mass.). p.5-18 of "Engineering Aspects of Magnetohydrodynamics." New York, Columbia University Press, 1962.

The construction, description, testing, and space-propulsion performance of a magnetic-annular-arc accelerator are described. (T.F.H.)

15011 EXPERIMENTAL MAGNETOGASDYNAMIC ENGINE FOR ARGON, NITROGEN, AND AIR. Sterge T. Demetriades (Northrop Corp., Hawthorne, Calif.). p.19-44 of "Engineering Aspects of Magnetohydrodynamics." New York, Columbia University Press, 1962.

Direct and unambiguous measurements of MGD (magnetogasdynamic) thrust are obtained with a continuous-flow MGD engine mounted on a balance. The engine is of rectangular geometry and uses steady crossed fields. Argon, nitrogen, and air are used as expellants and the electrodes are successfully operated in the field emission regime. The thrust of an argon plasma jet is augmented by 200%. Although an uncertainty of 15% exists in the propulsion efficiency measurements with argon expellant, nevertheless, the MGD efficiency obtained, excluding the plasma generator, is greater than 30% for argon. An uncertainty of 40% exists in the propulsion efficiency measurements with nitrogen or air expellants. However, the MGD engine efficiency obtained with nitrogen or air is greater than 10%. No specific attempt is made to optimize the geometry or efficiency of this MGD engine. The uncertainty in the efficiency measurements may be removed either by mounting the plasma generator on the balance along with the MGD driver or by direct and continuous measurement of the plasma generator exhaust velocity or cooling losses. (auth)

15012 EXPERIMENTS IN STEADY-STATE HIGH-DENSITY PLASMA ACCELERATION. Arlen F. Carter, George P. Wood, Alexander P. Sabol, and Richard H. Weinstein (Langley Research Center, Va.). p.45-55 of "Engineering Aspects of Magnetohydrodynamics." New York, Columbia University Press, 1962.

Experiments are described in which linear d-c crossed-field accelerators are used for the steady-state acceleration of moderately dense plasma. The accelerator and its related experimental difficulties (e.g., erosion) are described. (T.F.H.)

15013 EXPERIMENTAL RESULTS WITH A DIRECT CURRENT ELECTROMAGNETIC PLASMA ACCELERATOR. Domenico Ragusa (MHD Research, Inc., Newport Beach, Calif.) and Jerome Baker. p.56-63 of "Engineering Aspects of Magnetohydrodynamics." New York, Columbia University Press, 1962.

Experiments are described that indicate that the continuous acceleration of a plasma flow by means of crossed electric and magnetic fields is achieved; the level of acceleration is on the order of a 10% increase in velocity in most of the experiments conducted. The power dissipated in the secondary electrode discharge is consistently less than the power level of the gas passing through the accelerator; for instance, most experiments are done with a secondary power dissipation of less than 50% of the incoming power level. Since energy is related to the square of the velocity, a 10% increase in velocity would require a 20% increase in directed kinetic energy of the flow; therefore, results seem to indicate that on the order of 50% of the input electric power goes into directed kinetic energy of the flow. Experiments indicate that it is important to obtain a stable and uniform discharge between the two electrodes in the accelerating test section. The most effective electrode structure studied is the multiple-point structure. No severe problems are experienced with either the accelerator test section or the target-type thrust stand; however, tests show that accurate instrumentation is of great importance in order to achieve a meaningful interpretation of the flow and to evaluate the increases in thrust obtained. (auth)

15014 PLASMA ACCELERATION STUDIES. G. J. Rausa (Martin Co., Baltimore) and L. M. Gearhart. p.64-80 of "Engineering Aspects of Magnetohydrodynamics." New York, Columbia University Press, 1962.

In addition to indicating a lack of simplicity associated

with the experimental configuration, analysis of experimental data yields several important conclusions. In addition to the primary material (in this case an exploded wire), the imparting mass contains components arising from ablation of the electrodes and the insulator. There appears to be no motion of the spark roots, which observation indicates that the mechanism is similar to a blowout arc rather than a mobile circuit element. Gross measurements of momentum and energy dependence upon inductance per unit rail length, initial bank energy, and acceleration length tend to verify the slug model only qualitatively. Velocity measurements using probe techniques are strongly dependent upon the position of the probe. The same should be true of smear camera results (that is, the velocity interpreted should be dependent upon the position of the slit). (auth)

15015 THE DESIGN, FABRICATION, AND TEST OF A PULSED-PINCH PLASMA ENGINE FOR SPACE APPLICATIONS. James J. Pearson, Charles C. Cavalconte, William J. Guman, and Irving Granet (Republic Aviation Corp., Farmingdale, N. Y.). p.81-96 of "Engineering Aspects of Magnetohydrodynamics." New York, Columbia University Press, 1962.

The design, construction, test, and thrust characteristics of a pulsed-pinch prototype space-propulsion unit are described. The test equipment is also discussed. (T.F.H.)

15016 STAGNATION-POINT FLOW OF A MAGNETIZED BLUNT BODY IN HYPERSONIC FLOW. S. I. Pai (Univ. of Maryland, [College Park]) and E. T. Kornowski. p.97-106 of "Engineering Aspects of Magnetohydrodynamics." New York, Columbia University Press, 1962.

The inviscid hypersonic flow in the stagnation region of a magnetized blunt body is studied. The problem is formulated in such a way as to yield not only the effects of field strength, but also the effects of magnetic field configuration. The fundamental equations and the boundary conditions are given for a hypersonic, inviscid, and steady flow near the stagnation point of an arbitrarily magnetized body of revolution. Calculations are presented. The electrical conductivity in the free stream is assumed to be zero, while in the shock layer it is considered to be constant. The approximation of incompressible flow in the stagnation region is assumed. The general method of analysis includes the effects of electromagnetic forces. (auth)

15017 MAGNETOGASDYNAMIC SHOCK LAYER FLOW. C. A. Andrade (Bendix Systems Div., Ann Arbor, Mich.). p.107-20 of "Engineering Aspects of Magnetohydrodynamics." New York, Columbia University Press, 1962.

A steady-state, compressible, inviscid, shock-layer flow, interacting with a magnetic flux that emanates from a source distribution on a hypersonic body, is proposed. This configuration is accomplished with suitable initial values that satisfy the Rankine-Hugoniot relations at the shock front. The basic hypotheses for the computation are: a distribution of magnetic intensity is prescribed normal to the detached shock wave surface; and the shape of the shock wave is also prescribed, i.e., it is a member of a one-parameter family of conoidal surfaces. The solution proposed is an extension of the inverse method, whereby both pressure distribution and magnetic source distribution are to be found for a desired body. (auth)

15018 MHD POWER RESEARCH IN THE UNITED KINGDOM. B. C. Lindley (C. A. Parsons and Co., Ltd., Newcastle-upon-Tyne, Eng.). p.127-46 of "Engineering Aspects of Magnetohydrodynamics," New York, Columbia University Press, 1962.

Theoretical and experimental research on magnetohydrodynamic power generation is reviewed. Studies of ionized gases and magnetohydrodynamic flows are discussed, in their relation to power generation. (T.F.H.)

15019 PROGRESS IN MHD POWER GENERATION. T. R. Brogan, A. R. Kantrowitz, R. J. Rosa, and Z. J. J. Stekly (Avco-Everett Research Lab., Everett, Mass.). p.147-65 of "Engineering Aspects of Magnetohydrodynamics." New York, Columbia University Press, 1962.

Developments in the economical magnetohydrodynamic production of electric power are outlined, with particular attention to the characteristics of an oxygen preheater system and to the use of seeded combustion products as a working fluid. An experimental model magnetohydrodynamic generator is described. (T.F.H.)

15020 COMPARISON OF THEORETICAL AND EXPERIMENTAL RESULTS IN AN MHD GENERATOR. S. Way (Westinghouse Electric Corp., Pittsburgh). p.166-79 of "Engineering Aspects of Magnetohydrodynamics." New York, Columbia University Press, 1962.

It is shown to be possible to build MHD generators with open-circuit voltages closely approaching the theoretical value. To do this, leakage currents must be kept to a minimum. Theoretical conductivities for combustion products based on data for collision frequencies and an electron affinity of OH of 2.1 ev tend to run about 25% higher than values inferred from the MHD generator experiments, after making allowances for magnetic field, leakage currents, and thermal losses. The electrode potential drops for the conditions of the reported experiments are of the order of 2 or 3 v. Actual power is appreciably lower than the theoretical generated power for the actual gas conductivity when leakage currents are present; a double penalty is paid in that not only does a power loss exist in the leakage conductance, but also a larger ohmic loss is present in the main gas column as a result of the augmented current. Thermal losses ahead of the generator must be prevented to assure good fuel economy in an actual MHD plant. Thermal losses in the generator itself must be kept to a minimum because of adverse effects on electrical conductivity when the gas is unnecessarily cooled. Realization of the full potential of MHD power generation requires attention to thermal insulation and appropriate design measures to prevent internal leakage currents. (auth)

15021 MHD POWER-GENERATION STUDIES IN RECTANGULAR CHANNELS. Vernon H. Blackman (MHD Research, Inc., Newport Beach, Calif.), Malcolm S. Jones, Jr., and Anthony Demetriades. p.180-210 of "Engineering Aspects of Magnetohydrodynamics." New York, Columbia University Press, 1962.

Magnetohydrodynamic (MHD) experimental facilities, test results, and theoretical considerations are described, whose purpose is studies of the production of commercial MHD power. The experimental apparatus is described, as are the diagnostic systems. The fluid dynamics, chemical kinetics, and plasma properties of the system are examined. Channels of rectangular cross section are constructed, within which MHD power may be produced for times exceeding 10^3 sec, with highly efficient conversion of thermal energy to electric energy. (T.F.H.)

15022 MHD FOR POWER STATIONS. Stuart Hamilton (Pratt and Whitney Aircraft, East Hartford, Conn.). p.211-27 of "Engineering Aspects of Magnetohydrodynamics." New York, Columbia University Press, 1962.

Methods are shown for applying MHD (magnetohydrodynamics) to small power plants, particularly to peak-load stations. An approach toward optimizing a combined MHD-

gas-turbine power plant, and a method of generating alternating current, is presented. An analytic method is proposed for determining the values of total pressure level and other flow variables that establish maximum MHD generator output per unit size. Several gas turbine cycles are proposed to reduce cost of the MHD power plants for peak-load operation. (auth)

15023 THE MAGNETOHYDRODYNAMIC VORTEX POWER GENERATOR: BASIC PRINCIPLES AND PRACTICAL PROBLEMS. Coleman duP. Donaldson (Aeronautical Research Associates of Princeton, N. J.). p.228-54 of "Engineering Aspects of Magnetohydrodynamics." New York, Columbia University Press, 1962.

A brief review of the basic theory of laminar vortex power generators is made and the general characteristics of the solutions are discussed. Some of the major assumptions on which the laminar theory is based are pointed out. Those assumptions that are largely hydrodynamic in character are discussed in the light of such experimental data. The conclusion is made that the flow in practical vortex power generators is turbulent in nature, and that the turbulent profiles differ markedly from those obtained by use of the laminar theory using a constant effective eddy viscosity. Since the proper evaluation of the tangential-velocity profile in a vortex power generator is always the starting point in any theory of the performance, the development of a theory for the velocity distribution in incompressible turbulent conducting vortices is attempted. Although no actual velocity profiles computed by the method developed are measured, it appears that the theory is capable of describing properly the velocity distributions in turbulent vortices. (auth)

15024 AN ELECTRODELESS MHD GENERATOR. I. B. Bernstein (Princeton Univ., N. J.), J. B. Fanucci, K. H. Fischbeck, J. Jarem, N. I. Korman, R. M. Kulsrud, M. Lessen, and N. Ness. p.255-76 of "Engineering Aspects of Magnetohydrodynamics." New York, Columbia University Press, 1962.

The feasibility of adapting the theory of a-c induction generators to magnetohydrodynamic (MHD) power generation is investigated. In a MHD generator of this type, there is no problem of electrode erosion, because the plasma never touches the coils that produce the field. The basic equations, impedance functions, power output, efficiency, gasdynamics, and other characteristics of this type of MHD generators are detailed. (T.F.H.)

15025 SOME REQUIREMENTS FOR THE OPERATION OF MAGNETOHYDRODYNAMIC INDUCTION GENERATORS. H. H. Woodson and A. T. Lewis (Massachusetts Inst. of Tech., Cambridge). p.277-93 of "Engineering Aspects of Magnetohydrodynamics." New York, Columbia University Press, 1962.

A magnetohydrodynamic (MHD) induction generator is considered, whose purpose is the generation of single-frequency a-c power. This purpose leads to a generalized equivalent circuit that is necessary to fulfill the requirements. Analysis of the equivalent circuit shows some general properties of the system in terms of circuit parameters, and the circuit parameters may then be related to the properties of the working gas via experimental results on magnetically driven shock tubes. Conflicts between practicable and optimal sizes are discussed. (T.F.H.)

15026 A MAGNETOHYDRODYNAMIC POWER CONVERTER. W. D. Jackson (Massachusetts Inst. of Tech., Cambridge), E. S. Pierson, and D. A. East. p.294-306 of "Engineering Aspects of Magnetohydrodynamics." New York, Columbia University Press, 1962.

Design considerations for a magnetohydrodynamic device to alter d-c voltages (i.e., a converter) are given, for specified input voltage, output voltage, and output power. Optimization of operating efficiency is the goal of these considerations. It is concluded that fluid losses cannot be neglected, and that the working fluid should have as high an (electric conductivity/density) ratio as possible. Conclusions regarding the fluid velocity are also drawn. The steady-state theory of operation of this type of device is also reviewed, and a model converter is described. (T.F.H.)

15027 ELECTRICAL CONDUCTIVITY OF FLAME GASES SEEDED WITH ALKALI METALS AND APPLICATION TO MHD POWER PLANT DESIGN. N. R. Dibelius (General Electric Co., Schenectady, N. Y.), E. A. Luebke, and G. J. Mullaney. p.307-26 of "Engineering Aspects of Magnetohydrodynamics." New York, Columbia University Press, 1962.

The electric conductivity of propane-O_2 flame gases is determined with K_2CO_3, KOH, and CsCl as additives. Flame temperatures range from 1800 to 2400°K at 1 atm. The measured conductivities agree with the Saha equation and a "free path" kinetic theory. The results of the K measurements are applied to the calculation of magnetohydrodynamic generator designs for central power-plant applications. The effects of cycle-parameter variations on the generator performance are discussed. (T.F.H.)

15028 CONDUCTION IN GASES WITH ELEVATED ELECTRON TEMPERATURE. Jack L. Kerrebrock (Massachusetts Inst. of Tech., Cambridge). p.327-46 of "Engineering Aspects of Magnetohydrodynamics." New York, Columbia University Press, 1962.

A simple theory of nonequilibrium conduction in ionized gases is developed that accounts for the elevation of the electron temperature by energy gain in the electric field. It is assumed that the ionization is in equilibrium at the electron temperature. The theory yields a modified Ohm's law such that the current density varies as a power of the electric field. The power is unity for gases at high temperatures, but can be very large at low gas temperatures. Measurements carried out with hot tantalum electrodes in an argon-potassium plasma at temperatures between 1500 and 2500°K, at atmospheric pressure, agree with the predicted variations of the conductivity with both current density and gas temperature. This result is regarded as a verification of the assumption of ionization equilibrium at the electron temperature. (auth)

15029 PLANE-MAGNETOACOUSTIC-WAVE PROPAGATION THROUGH A STRATIFIED MEDIUM. Norman C. Jen (City Coll., New York). p.355-9 of "Engineering Aspects of Magnetohydrodynamics." New York, Columbia University Press, 1962.

Plane-wave propagation in an infinitely conductive medium with nonuniform density and nonuniform magnetic-field strength is studied. These physical properties vary in exponential form in the direction of wave propagation. (auth)

15030 MICROWAVE REFLECTION AND ABSORPTION BY A NONUNIFORM PLASMA SHEATH. Leonard S. Taylor (General Electric Co., Philadelphia). p.360-74 of "Engineering Aspects of Magnetohydrodynamics." New York, Columbia University Press, 1962.

The equations for the propagation of an electromagnetic wave into a plane stratified medium are reduced into the transmission-line equations, in which form the inductive capacities of the medium determine the parameters of an equivalent tapered transmission line. A numerical solution of these parameters may be obtained by replacing the ta-

pered line by a chain of lumped parameter elements. This replacement is carried out for a known solution of the differential equation for the reflection coefficient of a nonuniform transmission. The form of the replacement for the known solution is used to determine the reflection coefficient from a medium in which the ionization density profile is a ramp step terminating in a reflecting wall. This profile is intended as a crude approximation to the atmospheric ionization profile. It is noted that the results are independent of the angle between the plane of the waves and the plane of the stratifications. The application of the results to the diagnostics of re-entry vehicles and shock-tunnel models is discussed. (T.F.H.)

15031 SHOCK-TUBE-MICROWAVE PROPAGATION MEASUREMENTS USING THE DIELECTRIC-SLAB APPROXIMATION. F. L. Tevelow and H. D. Curchack (Diamond Ordnance Fuze Labs., Washington, D. C.). p.375-89 of "Engineering Aspects of Magnetohydrodynamics." New York, Columbia University Press, 1962.

Transient plasma measurements, made using a microwave bridge and a shock-generated plasma where plasma dimensions are comparable to the test wavelength, are reported. The assumption is made that the waveguide, which contains the plasma slab, is completely filled and that the plasma is uniform. These boundary conditions allow rigorous theoretical analysis, which includes reflections at the slab interfaces and the effects of electron-atom collisions. Data are reproducible, and densities from 10^{10} to 10^{13} electrons-cm^{-3} can be detected using a 10-kMc test signal. (auth)

15032 RERADIATION SPECTRUM BROADENING OF HARMONICALLY DRIVEN PLASMA ELECTRONS. Srbislav Zivanovic (Bendix Corp., Chicago). p.390-404 of "Engineering Aspects of Magnetohydrodynamics." New York, Columbia University Press, 1962.

The reradiated frequency spectrum of a sheet plasma of average thickness less than twice the mean free path of electrons is obtained, under assumptions that are listed. As a result of the random motion of the particles, the reradiated electric field has, besides a component collinear with the electric field of the incident wave, a component collinear with the magnetic field of the incident wave. The final reradiated spectrum depends on the velocity distribution function. A distribution function with a large standard deviation, which allows for a large percentage of high-velocity electrons, leads to a broad frequency spectrum. A temperature rise increases the standard deviation of the distribution function and consequently broadens the spectrum. The spectral broadening caused by the collision frequency of the electron enters into the formulation in a very specific way, clearly limiting the magnitude of the spectrum at that point. A specific magnitude limitation is offered, whose effect on the overall result is somewhat uncertain. (auth)

15033 SOME ASPECTS OF A NONLINEAR ELECTRICAL CONDUCTIVITY ON PROPAGATION OF ELECTROMAGNETIC WAVES. Melvin Epstein (Univ. of Southern California, Los Angeles). p.405-18 of "Engineering Aspects of Magnetohydrodynamics." New York, Columbia University Press, 1962.

Sufficient experimental data do not exist for gases at high temperatures, when subjected to an applied electromagnetic field, to indicate conclusively in what manner the electron-neutral-particle collision frequency varies as a function of electron velocity. Physical arguments are given that indicate that the assumption of constant free path may be more valid than assuming constant collision frequency under these conditions. The current density is then shown to depend nonlinearly on the strength of the applied field. An approximation is obtained to the electrical conductivity, valid for high frequencies, which is simple enough to use in further analyses. In this approximation, the nonlinearity affects only the part of the current that is in phase with the field. The magnitude of the nonlinearity depends on the ratio of the energy the electrons acquire from the field to the internal energy of the gas, and is large when the field is large and/or the mean free path is large. The nonlinear current-density field-strength relation is then applied to the problem of propagation of a plane wave in a uniform medium. The results of the analysis indicate that including the nonlinear term results in increased attenuation of the wave, the relative increase in attenuation increasing with increasing frequency. Similarly, it is found that the propagation velocity of the wave is decreased relative to the linear propagation velocity, the reduction being greatest for small frequencies. (auth)

15034 SPACE-CHARGE WAVES AND PLASMA DIAGNOSTICS. A. W. Trivelpiece (Univ. of California, Berkeley). p.419-37 of "Engineering Aspects of Magnetohydrodynamics." New York, Columbia University Press, 1962.

The conventional microwave transmission method of plasma diagnostics is described. It is noted that under certain circumstances the model used for analysis and the actual physical situation may be quite different. That is, a one-dimensional slab of plasma is assumed for analysis, while, in fact, the plasma may be a cylinder whose diameter is comparable to or less than the wavelength of the probing microwave signal. Several of the essential features of the characteristic modes of propagation on a cylindrical plasma column in a finite axial magnetic field are discussed and reviewed. It is pointed out that these space-charge-wave modes might be excited by the diagnostic probing signal, thus diverting some of the probing signal from the receiving antenna. This would, of course, introduce an error in the measured values of collision frequency and plasma frequency. A simple model of a plasma-filled cylindrical waveguide (cutoff when empty) immersed in an infinite axial magnetic field is analyzed for the special case of a uniform, azimuthally symmetric, z-directed exciting field, such as might be set up by a cylindrical cavity surrounding the plasma. It is concluded that whenever the product of the cavity-gap distance and the space-charge-mode wavenumber is the order of unity, the real shunt impedance across the cavity as a result of space-charge-wave excitation cannot be neglected in evaluating the physical constants of the plasma. (auth)

15035 ON SPECTROSCOPIC INFORMATION FROM A PLASMA. G. R. Peacock and G. Lanza (Northwestern Univ., Boston). p.458-64 of "Engineering Aspects of Magnetohydrodynamics." New York, Columbia University Press, 1962.

The theory and experimental feasibility of the use of a pulsed-Zeeman-effect method for plasma diagnostics is discussed. Experimental results using exploding-wire and pulsed-arc plasmas are indicated. (T.F.H.)

15036 THERMONUCLEAR POWER AND SUPERCONDUCTIVITY. R. G. Mills (Princeton Univ., N. J.). p.515-20 of "Engineering Aspects of Magnetohydrodynamics." New York, Columbia University Press, 1962.

It is shown that the use of superconducting magnets in fusion power plants increases the plant efficiency, allows smaller plants to be built, and allows pilot-size plants to be built. The economics of operation of normal- and

superconducting-magnet power plants at specified power levels are outlined. (T.F.H.)

15037 PRODUCTION OF A PLASMA WITH HIGH-POWER, PULSED MICROWAVES. Thomas Fessenden (Massachusetts Inst. of Tech., Cambridge). p.529-41 of "Engineering Aspects of Magnetohydrodynamics." New York, Columbia University Press, 1962.

Experimental observations are made concerning the production of a dense plasma with high-power, pulsed, microwave energy. It is concluded that a dense plasma in a resonant cavity can be produced in a few microseconds by a high-power pulse of microwave energy. It is also found that the cavity should be excited at frequencies near the resonant frequency of a cavity mode obtained when the volume normally occupied by the plasma is replaced by a perfect conductor (that is, a cavity mode should be used that requires the presence of the plasma for its existence). The electron density and collision frequency of a dense plasma in a resonant cavity can be related to the amount of detuning produced by the plasma. A perturbation theory that assumes that the plasma is a perfect conductor in the unperturbed case can be used for calculating the parameters of the plasma from measurements of the detuning of the cavity. (auth)

15038 SWITCHING OF HIGH CURRENTS IN FAST AND SLOW PLASMA-COMPRESSION SYSTEMS. W. F. Westendorp (General Electric Co., Schenectady, N. Y.). p.542-53 of "Engineering Aspects of Magnetohydrodynamics." New York, Columbia University Press, 1962.

A fast switching system is described that uses four simultaneously fired, pressurized spark gaps. The system switches a 384 kjoule, 60-kv capacitor bank into a magnet coil carrying 3.1 Ma. This coil produces a magnetic field of 160 kOe around a vacuum plasma chamber. A slow switching system is described that transfers 2 Mjoule of electric energy in 1 msec to a pair of coaxial coils that are arranged to produce a mirror field. An ignitron bank is used to crowbar this slow-switch discharge, in addition to a mechanical crowbar. (T.F.H.)

15039 FEASIBILITY STUDY OF A TRANSIENT VERSION OF THE ASTRON THERMONUCLEAR REACTOR. Chieh C. Chang (Univ. of California, [Livermore]). p.554-70 of "Engineering Aspects of Magnetohydrodynamics." New York, Columbia University Press, 1962.

The advantages of studies on a transient version of the Astron thermonuclear machine (TVA) are enumerated. The TVA discussed consists of a plasma supply in which two self-pinched plasma rings are generated at opposite ends of a cylindrical chamber, by individual homopolar machines; these rings are injected symmetrically into the chamber along the E layer, and are thermalized to fusion temperatures by collisions, compressions, and shocks. The analyses that can be carried out by means of this machine are discussed, including: establishment and dynamics of the E layer; plasma-ring interaction dynamics; Astron operation; and plasma thermalization. The feasibility of construction of a TVA machine is outlined. (T.F.H.)

Astrophysics and Cosmology

15040 INTERPRETATION OF X-RAY PHOTOGRAPH OF THE SUN. R. L. Blake, T. A. Chubb, H. Friedman, and A. E. Unzicker (U. S. Naval Research Lab., Washington, D. C.). Astrophys. J., 137: 3-15(Jan. 1963).

An x-ray picture of the sun was obtained on April 19, 1960, using pinhole-camera photography. Photometric analysis of the picture has shown that at least 75 per cent of the x radiation passed by the pinhole window material emanated from condensations in the lower corona localized above CaK plages. The "x-ray plages" appear to be of smaller dimension than the corresponding calcium plages. A strong correlation exists between the distribution of sources of x-ray emission and decimeter wave emission. When allowance is made for the transmission of the camera window material and the spectral sensitivity of the photographic film, it is estimated that the solar x-ray flux (0-60 A) at the earth was about 0.3 erg cm^{-2} sec^{-1} assuming a Planckian solar x-ray spectrum characterized by a temperature of $10^{6.9}$K. There is evidence for only a small amount of limb brightening in the non-plage background emission. The measured emission extended to about 43000 km beyond the optical limb. (auth)

15041 CORONAL TEMPERATURE GRADIENT AND THE SOLAR WIND. Donald E. Billings and Carl G. Lilliequist (Univ. of Colorado, Boulder). Astrophys. J., 137: 16-20(Jan. 1963).

Analysis of data taken October 13, 1959, on λ5303 in one part of the corona yields evidence for a negative temperature in the inner corona. Influence of a solar wind on line profiles is examined, and calculated solar wind velocities are found insufficient to produce significant broadening of coronal lines. (D.C.W.)

15042 CORONAL IONIZATION BY TWO-STEP COLLISION PROCESSES. R. Grant Athay and Charles L. Hyder (Univ. of Colorado, Boulder). Astrophys. J., 137: 21-5 (Jan. 1963).

That ionization by electron impact for some coronal ions may take place via the double process of collisional excitation to metastable levels, thence collisional ionization from these excited levels rather than by direct ionization from the ground state is suggested. The relative efficiency of this double-collision process depends primarily on the mean decay lifetimes for the excited levels. A specific computation based on estimated upper limits to the mean lifetimes of excited levels in the Fe x–Fe xv sequence shows a flatter spectrum of ion densities and a somewhat lower ionization temperature than is obtained from direct collisional ionization from the ground state, assuming that the abundance of Fe x equals that of Fe xiv. The two-step collision mechanism permits the possibility of a density dependence in the ionization equilibrium. (auth)

15043 PHYSICAL CONDITIONS IN LIMB FLARES AND ACTIVE PROMINENCES. VI. SELECTIVE EXCITATION CONDITIONS. Einar Tandberg-Hanssen (Univ. of Colorado, Boulder). Astrophys. J., 137: 26-37(Jan. 1963).

The complex surge prominence of November 18, 1960, is studied spectroscopically. It is shown that the surge consists of different regions, where the physical conditions (temperature and/or internal motions) differ from one region to another. The metal and helium regions are shot out from an underlying flare in different directions. We notice that the emission from Fe II is considerably fainter than that from Ti II or Ba II. A finer spectroscopic classification of flares and prominences than that previously introduced is discussed. While Ti II lines are generally stronger than Fe II lines in prominences, the reverse holds true in flares. The line-intensity ratio M = [I(Fe II, 4584)/I(Ti II, 4572)] is introduced as a new classification criterion. (auth)

15044 DYNAMIC SPECTRA OF JUPITER'S DECAMETRIC EMISSION, 1961. James W. Warwick (Univ. of Colorado, Boulder). Astrophys. J., 137: 41-60(Jan. 1963).

Sources for the decametric emission from Jupiter are suggested and evidence for their existence presented.

Dynamic spectra for negative and positive drift emission and composite spectra are displayed and discussed. An explanation of the emission based on Jupiter's possession of energetic radiation belts similar to earth's is presented. (D.C.W.)

15045 RED GIANTS WITH EXTREME METAL DEFICIENCIES. George Wallerstein (Univ. of California, Berkeley), Jesse L. Greenstein, Robert Parker, H. L. Helfer, and Lawrence H. Aller. Astrophys. J., 137: 280-300 (Jan. 1963).

The three field stars, HD 122563, HD 165195, and HD 221170, similar to giants in metal-poor globular clusters, show decreases in the average metal/hydrogen ratios by factors of 800, 500, and 500, respectively, compared with the sun. The abundance ratios of other elements to iron resemble those in the sun, with important exceptions. Manganese and vanadium are deficient with respect to iron, by a factor of 3. In HD 122563 all elements heavier than zinc are deficient compared with iron by a factor of 50, yielding a total deficiency of about 50000 for the heavy elements. These observations are interpreted by assuming that the elements were synthesized from hydrogen early in the history of our Galaxy. These stars were formed when the interstellar medium was almost entirely hydrogen, between 10^7 and 10^9 years after star formation began. Their metallic constituents were formed and ejected from massive, rapidly evolving stars of extremely low metal content. Processing at high temperatures synthesized the elements from sodium through nickel which are now present in all three stars. The material that went into HD 122563 is drastically deficient in all elements produced by the addition of neutrons to the iron peak, whereas light elements produced by neutron addition — aluminum and scandium — exist in normal amounts or are only slightly deficient. We interpret this to mean that when a flux of free neutrons became available, the progenitors of the light s-process elements were present, but the iron peak elements were rare or absent. The europium in HD 122563 may have been produced by the s-process, a very unexpected result. The presence of europium in HD 165195, in at least the normal ratio to the other elements, raises difficulties concerning r-process nucleosynthesis, since type I supernovae of small mass may not have begun to appear at the early epoch when the star was formed. 37 references. (auth)

15046 NEUTRINO PROCESSES AND RED GIANTS. Hong-Yee Chiu (Goddard Inst. for Space Studies, New York and Columbia Univ., New York). Astrophys. J., 137: 343-4 (Jan. 1963).

Rate of energy loss due to neutrino emission in high density, low temperature stellar plasma is discussed, and the direct evolution of stars into white dwarfs without supernova explosion when neutrino energy flux or gravitational energy flux is considered. Using red giant models, the energy fluxes are calculated and found comparable. (D.C.W.)

15047 SOLAR NEUTRINO FLUX. J. N. Bahcall, William A. Fowler, I. Iben, Jr., and R. L. Sears (California Inst. of Tech., Pasadena). Astrophys. J., 137: 344-5(Jan. 1963).

The Be^7 decay rate and the expected neutrino flux at the earth from B^8 decays in the sun are calculated. About one-half the detectable solar neutrinos are estimated to be from B^8 decays, using the Iben and Sears model. Neutrino flux detection and the effective neutrino-generation temperature are also discussed. (D.C.W.)

15048 A NEW METHOD OF DIRECTLY MEASURING THE GALACTIC MAGNETIC FIELD. B. G. Clark (California Inst. of Tech., Pasadena). Nature, 197: 474(Feb. 2, 1963).

A new method is described for directly measuring the galactic magnetic field. The method is based on measurements of Faraday rotation of the plane of polarization due to the presence of anomalous dispersion in the neighborhood of the 21-cm line of natural hydrogen and utilizes data on the existence of polarization in the Crab Nebula at a wave-length of 21 cm. (C.H.)

15049 NATURE OF STRONG RADIO SOURCES. F. Hoyle and William A. Fowler (California Inst. of Tech., Pasadena). Nature, 197: 533-5(Feb. 9, 1963).

The possibility is examined that masses of gas, 10^5 to 10^8 sun masses, may accumulate at the center of galaxies and may behave as stars. The existence of such objects is supported theoretically by the energy requirements of strong radio galaxies that seem to demand large aggregations that either draw on nuclear energy or on the very considerable gravitational energy that can arise in a massive body of stellar dimensions. Observations on the Seyfert galaxies are reviewed in support of this theory. (C.H.)

15050 INTERACTIONS OF SOLAR PLASMA WITH THE GEOMAGNETIC FIELD. J. W. Dungey (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Planetary Space Sci., 10: 233-7(1963).

The Chapman-Ferraro theory of solar plasma–geomagnetic field interactions is outlined. The interaction when there is an interplanetary field is considered, and leads to an interpretation of the auroral zones. Results from Explorer XII tend to confirm this model. The motion of the auroral primaries is briefly discussed. (auth)

15051 MAGNETIC FIELD. E. J. Smith (California Inst. of Tech., Pasadena), Leverett Davis, Jr., P. J. Coleman, Jr., and C. P. Sonett. Science, 139: 909-10(Mar. 8, 1963).

Mariner II magnetometer data give no indication of a Venusian magnetic field. This result implies, by comparison with spacecraft measurements near Earth and with theoretical models, that the magnetic dipole moment of Venus is at most $1/10$ to $1/20$ that of the earth. (auth)

Cosmic Radiation

15052 (AMRL-TDR-62-86) SPACE RADIATION GUIDE. W. P. Saylor, D. E. Winer, C. J. Eiwen, and A. W. Carriker (American Machine and Foundry Co., Alexandria, Va.). Aug. 1962. Contract AF33(616)-7631. 210p.

Information on the effects, existence, nature, and origin of radiations in space is presented. Implications for space flight are also considered. 200 references. (D.C.W.)

15053 (NASA-TN-D-1547) DELINEATION OF TRACKS OF HEAVY COSMIC RAYS AND NUCLEAR PROCESSES WITHIN LARGE SILVER CHLORIDE CRYSTALS. Charles B. Childs (North Carolina. Univ., Chapel Hill and National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.) and Lawrence M. Slifkin (North Carolina. Univ., Chapel Hill). Mar. 1963. 8p.

Tracks of energetic charged particles, such as heavy primary cosmic rays and the products of nuclear collisions, have been made visible within the interior of large, transparent crystals of silver chloride. The tracks are delineated by photoelectric formation of metallic silver along them. This technique may be useful as a convenient and distortion-free method for the study of heavy primaries and fission fragments. Tracks of the same particle in emulsion and in the crystal are displayed. (auth)

15054 (NASA-TN-D-1717) ENERGY SPECTRUM OF ELECTRONS IN THE OUTER RADIATION BELT. Wilmot N. Hess and John A. Poirier (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.). Mar. 1963. 15p.

The equilibrium energy spectrum of electrons in the outer radiation belt is determined by the injection spectrum and the loss processes that operate to remove the electrons or change their energy. The loss processes considered here are ionization energy loss, multiple scattering, and electron-electron scattering; the injection spectra considered are neutron β-decay electrons and monoenergetic electrons of 780 and 20 kev. The problem is treated numerically. The results of the numerical calculation are compared with recent measurements of the outer-belt electron spectrum; it appears that neutron decays produce a reasonable fraction of the outer-belt electrons, but other processes such as acceleration may be important. 27 references. (auth)

15055 (RM-3144-PR) SPACE GEOMAGNETISM, RADIATION BELTS, AND AURORAL ZONES. E. H. Vestine (RAND Corp., Santa Monica, Calif.). July 1962. Contract AF49(638)-700. 33p. (AD-278475)

The nature of the geomagnetic field and a few variations from ground level out to about 10 earth radii is discussed. Regions of trapped radiation are noted. The unshielded dosages during a great solar event on a few days per decade exceed limits of human safety. Modest shielding of somewhat less than 1 gm/sq cm will not remove the hazards. The chance is probably only one in several thousand that this will not suffice to preserve life on any given day. Transient accelerations of trapped particles result in atmospheric effects such as the aurora, and the polar electrojets, but the cause of these accelerative actions is quite obscure. (auth)

15056 AZIMUTHAL μ-MESON TELESCOPE. L. V. Kozak, E. V. Kolomeyets, L. A. Mirkin, B. A. Prilepskii, and V. I. Roshchupkin. Geomagnetizm i Aeronomiya, 2: 1148-50(Nov.-Dec. 1962).

An azimuthal μ-meson telescope was installed for continuous recording of the directional intensity of the cosmic-ray hard component. It consists of four identical sections divided into pairs, which record particles arriving at an identical zenith angle but from opposite azimuths. Each section consists of three rows, each with three counters arranged in parallel. A lead screen 10 cm thick is placed between the middle and lower row to separate the hard component. To increase the life of counters by a factor of 2 to 3, each counter has a quenching circuit, which cuts off the trailing edge of the pulse. The quenching circuits have the following parameters: duration of quenching pulse, ≥ 20 μ sec; build-up time, ≤ 5 μ sec; amplitude, ≥ 100 v; output pulse applied to the coincidence circuit, ≥ 35 v. The counter rows are connected to a triple coincidence circuit, which yields a pulse amplitude of ~11 v at the output and has a resolution of 1 μ sec. The coincidence circuit pulses are fed to a discriminator, which produces rectangular pulses at the output, which are then fed to a radiometer. (OTS)

15057 COSMIC-RAY EQUATOR FROM DATA OBTAINED BY THE THIRD SOVIET SPACESHIP-SATELLITE. I. A. Savenko, V. Ye. Nesterov, P. I. Shavrin, and N. F. Pisarenko. Iskusst. Sputniki Zemli, No. 11, 30-4(1961).

The use of the third Soviet spaceship-satellite in determining the line of minimal primary cosmic ray intensity, called the primary cosmic-ray equator, is described. (auth)

15058 PRIMARY COSMIC-RAY ALPHA PARTICLES. [PART] III. M. W. Friedlander and C. T. Spring (Washington Univ., St. Louis). Nuovo Cimento (10), 26: 1292-1300 (Dec. 16, 1962). (In English)

Nuclear photographic emulsions were exposed to the cosmic radiation on a high altitude balloon flight at 49° N geomagnetic latitude on 3rd August 1958. The total flux of primary alpha-particles, having kinetic energies greater than 400 Mev/nucleon, was found to be (87 ± 8) particles/m^2 ster s. Simultaneously, another set of emulsions was exposed at 61° N geomagnetic latitude. A comparison of the data obtained from the two flights leads to an estimate of the geomagnetic cut-off for 49° N as (500 ± 50) Mev/nucleon kinetic energy. (auth)

15059 NEW INDICATIONS OF THE EXISTENCE OF PHOTON-INITIATED E.A.S. R. Firkowski (Nuclear Research Inst., Polish Academy of Science, Lodz, Poland). J. Gawin, A. Zawadzki, and R. Maze. Nuovo Cimento (10), 26: 1422-5(Dec. 16, 1962). (In English)

An analysis of the results of several long period observations was given as a new indication of the existence of photon-initiated extensive air showers (EAS). An 18-month and a 10-month observation with M = 56 and M = 104 hodoscopic cells, respectively, were given. (C.E.S.)

15060 CONSTANCY OF COSMIC RAYS IN TIME. D. Heymann and O. A. Schaeffer (Brookhaven National Lab., Upton, N. Y.). Physica, 28: 1318-23(Dec. 1962). (In English)

The relative production ratio of Ar^{39}/Cl^{36} in iron by 6.2-Bev protons is measured to be 0.96 ± 0.05. This ratio is compared to the Ar^{39}/Cl^{36} ratio of 0.98 ± 0.05 found in iron meteorites whose date of fall to the earth is known. It is concluded that the ratio of the average cosmic ray intensity during the last 300 years is 1.02 ± 0.07 times the average cosmic ray intensity during the last 300,000 years. In this sense, cosmic ray intensity is essentially unchanged in time. (auth)

15061 AURORAL X-RAYS, ELECTRON BOMBARDMENT AND TRAPPED RADIATION. Paul J. Kellogg (Univ. of Minnesota, Minneapolis). Planetary Space Sci., 10: 165-78(1963).

Measurements of the characteristics of energetic particles incident on the top of the atmosphere, presumably precipitated from the earth's trapped radiation, are discussed. The incident flux varies widely, from 10^8 to 10^{10} particles/cm^2 sec for electrons. Other characteristics of the flux also vary from event to event, independently of the flux and of each other. During the most intense events, which are the ones that correspond to aurorae, the lifetime of an electron in the trapping region is only a few seconds. Clearly, violent processes go on during such events, so violent as to destroy the effectiveness of the trap. Several mechanisms are examined, and it is concluded that no one process accounts for all observations. (auth)

15062 PROTON BOMBARDMENT IN AURORA. Y. I. Galperin (Inst. of Physics of the Atmosphere, Moscow). Planetary Space Sci., 10: 187-93(1963).

The proton aurora, which systematically appears in the auroral zone, often during quiet magnetic conditions, and moves toward the equator with rising magnetic disturbance, is studied. The "hydrogen field" is a wide nearly homogeneous band with borders along magnetic parallels. There is no conclusive evidence of the concentration of hydrogen emission in any other distinct auroral form. The magnetic zenith emission profile is nearly constant with only minor variation. The height of the emission in the hydrogen field

and the low-energy part of initial proton energy spectrum are discussed. (auth)

15063 THE PART PLAYED BY AND SOURCE OF PARTICLES OBSERVED IN THE IONOSPHERE AND AURORAE. G. S. Ivanov-Kholodnyi (Inst. of Applied Geophysics, Moscow). Planetary Space Sci., 10: 219-32(1963).

The source and acceleration of electrons that penetrate deep into the atmosphere, and the connection these electrons have with aurorae, are surveyed. (auth)

15064 SOME RESULTS OF ROCKET MEASUREMENTS OF THE ELECTRON CONCENTRATION IN THE IONOSPHERE UP TO HEIGHTS OF 200 KM MADE IN 1959-1960. V. A. Rudakov. Planetary Space Sci., 11: 59-60 (Jan. 1963). (Translated by H. S. H. Massey from Iskusst. Sputniki Zemli, No. 10, p.102, 1961).

A dispersion radiointerferometer was used in conjunction with sounding rockets to determine the electron concentrations from the difference in phases of coherent oscillations emitted from the rockets. Three curves on a height vs electron concentration graph are given for rocket firings on July 14 and 22, 1959, and June 15, 1960. It is concluded that the electron concentration increases almost steadily in the ionosphere illuminated by the sun at heights up to 200 km with small maxima in the region of 100 to 125 km. (D.L.C.)

15065 INVESTIGATIONS OF THE SUN'S X-RADIATION. II. MEASUREMENTS WITH SPACE SATELLITES. S. L. Mandel'shtam, I. P. Tindo, Yu. K. Voron'ko, B. N. Vasil'yev, and A. I. Shurygin. Planetary Space Sci., 11: 61-71(Jan. 1963). (Translated by R. E. Daisley from Iskusst. Sputniki Zemli, No. 11, p.3, 1961).

Measurements are reported of the sun's x-ray intensity at wavelengths less than 10 A, obtained on Aug. 19 to 20 and Dec. 1 to 2, 1960, during the flights of the second and third satellites. The detection equipment are described: the orbit heights of the satellites ranged from 187 to 340 km. High count rates occur mainly in the sunlit part of the orbits, although high rates were observed in some sections of the orbit in the earth's shadow, probably due to the radiation belts. (D.L.C.)

15066 BROAD ATMOSPHERIC SHOWERS OF COSMIC RAY ORIGIN. S. I. Nikol'skii. Usp. Fiz. Nauk, 78: 365-410(Nov. 1962). (In Russian)

The passage of high-energy, cosmic radiation ($E_0 > 10^{13}$ ev) through the atmosphere results in the formation of "showers" of particles. Two important parameters in studying these particle showers are the total number of particles in a shower, and finding the axis of the shower by assuming a symmetrical decrease in particle density from the axis of the shower. A network of several thousand counters, including coincidence and anti-coincidence counters, may be spread out over an area of 60 to 100 m^2 to collect the required data. The energy of the primary particle causing the shower can be estimated from the total number of particles in the shower, and spacial distribution of the particles in the shower. Neutron counters surrounded with lead filters 1 to 4 cm thick are used to estimate the heavy nuclei in a shower. Methods of determining the spacial distribution of charged particles in a shower are expounded for distances of 1 to 25 meters from the axis of the showers with a total number of shower particles $N > 10^5$ at sea level. The spacial distribution and energy spectrum of μ-mesons at sea level and at 3860 meters are compared. Measurements at 3860 meters above sea level show that the number of bare nuclei in a shower having a total number of particles of 10^5 to 10^6 is significantly less than in a shower with $N < 5 \times 10^4$. Data on the energy spectrum of bare nuclei are presented. The fraction of the total energy of a shower carried by the various components is estimated. (TTT)

Criticality Studies

15067 (GA-3422) MEASURED DOPPLER COEFFICIENT OF THORIUM DISPERSED IN GRAPHITE. J. R. Brown and J. B. Sampson (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Feb. 6, 1963. Contract AT(04-3)-314. 71p.

The Doppler coefficient in thorium dispersed in graphite was measured in a reactor spectrum developed in the HTGR critical assembly, using a reactivity technique that compares the reactivity of a single cold element and a single hot element heated to 700°K. The considerable correction due to the small perturbation in neutron temperature resulting from the heating has been experimentally determined by auxiliary measurements. An activation technique has been used to check the results. In this activation technique, the thermal-base effect has also been experimentally subtracted by measuring the 1/v component of the captures at each temperature in vanadium. Measurements of the Doppler coefficient obtained by these two different techniques agree to within 10%. This agreement, demonstrated by applying both techniques for the first time in the same laboratory, shows that the previously reported spread of results and apparent disagreement between results of these two techniques are avoidable. The average Doppler coefficient for the temperature interval from 300 to 700°K, for a carbon-to-thorium ratio of about 50 in the thorium-bearing region, was measured to be 3.6×10^{-4}/°C to within about 10% uncertainty. The measured results are in satisfactory agreement with calculated values. (auth)

15068 (NAA-SR-Memo-7675) SENSITIVITY OF CLEAN CORE SGR CRITICAL ASSEMBLY CALCULATIONS TO PARTICULAR CHANGES IN INPUT DATA AND GROUP THEORY. D. F. Hausknecht (Atomics International. Div. of North American Aviation Inc., Canoga Park, Calif.). Aug. 30, 1962. Contract [AT(11-1)-Gen-8]. 14p.

A parameter survey of clean core SGR critical assembly calculations using both early and recent values for the thermal absorption cross section for graphite and the self-shielding factors for U^{235} and U^{238} has been performed. Also, two-group results have been compared with those of a similar four-group calculation. Four-group theory leads directly to results which are the most compatible with experiment to date, while an unlikely value of σ_a^C must be used for input data to the two-group method to obtain good results. (auth)

15069 (ORNL-TM-470) PROMPT NEUTRON DECAY IN A TWO-COMPONENT ENRICHED URANIUM METAL CRITICAL ASSEMBLY. J. T. Mihalczo (Oak Ridge National Lab., Tenn.). Jan. 11, 1963. Contract [W-7405-eng-26]. 13p.

Critical experiments in which the 8 × 10 in. surfaces of two U (93.2-wt % U^{235}) metal slabs were separated from 0 to 5 in. showed that the neutron flight time across the gap between the two slabs significantly affects the prompt neutron decay constant in the critical assembly. The prompt neutron decay constant, measured by the Rossi-α technique, varied from 1.07×10^6 sec^{-1} to $\sim 8.8 \times 10^5$ sec^{-1} over this separation range. Expressions for the prompt neutron lifetime in critical assemblies with large gaps are developed and a proposed calculational method is indicated. The

dependence of critical slab thickness on separation of the two slabs is given. (auth)

15070 APPROXIMATE ITERATIVE METHODS APPLIED TO "NON-SEPARABLE" MULTIPLYING SYSTEMS IN THE BASIC SYMMETRY. C. Lo Surdo (SORIN, Milan). Energia Nucl. (Milan), 9: 570-4(Oct. 1962). (In Italian)

The matrical formulation (with an arbitrary energy group number) of an iterative method for the calculation of the reproduction factor is given with emphasis on "non-separable" multiplying systems and the approximation of the diffusion theory. (auth)

Elementary Particles and Radiations

15071 (CERN-63-1) TWO PROGRAMMES FOR THE IBM 709 COMPUTER TO CALCULATE MULTIPLE PHASE SPACE INTEGRALS AND HIGH ENERGY PARTICLE PRODUCTION. D. J. Jones (European Organization for Nuclear Research, Geneva). Jan. 16, 1963. 88p.

Two IBM 709 Fortran programs are described. The first calculates phase space integrals and kinetic energy spectra for different channels into which a given initial state may go. The second calculates the probabilities for these channels and forms the weighted sum of the spectra of the different particles over all channels included in the analysis. The user specifies the initial state, the channels into which the initial state may go, the quantum numbers (mass, spin, isospin, strangeness, and nucleon number) and the "interaction volumes" of the particles produced. The final results (according to statistical theory) are probabilities for each channel separately; sums of probabilities for any set of channels specified; kinetic energy spectra (averaged over c.m. angles) of each particle produced, including those originating from two-body and three-body decays in the final state; the average multiplicity of each kind of particle; and the average kinetic energy of each kind of particle. On request, the spectra (that contain statistical fluctuations, as they result from Monte Carlo calculations) are smoothed out and graphs are plotted. The programs check for trivial mistakes made by the user (e.g., violation of strangeness conservation) and reject any incorrect data. (auth)

15072 (CTSL-38) K LEPTONIC DECAY AND PARTIALLY-CONSERVED CURRENTS. George Zweig (California Inst. of Tech., Pasadena. Synchrotron Lab.). Jan. 17, 1963. Contract AT(11-1)-68. 26p.

An operational definition for the partial conservation of the strangeness changing vector current is given and applied to leptonic K^+ and K_2^0 decay. The K^* resonance is explicitly included in the calculation and quantitative agreement with experiment is obtained. A detailed comparison with the K^+ data of Brown and Dobbs is given. Because of rapid variations of a form factor, it is found that the data of these two groups are not in contradiction. From the K_2^0 experiment of Luers, $I = \frac{1}{2}$ and $\frac{3}{2}$ currents are seen to exist. Λ β-decay is briefly considered. It is found that an explanation for the slowness of K leptonic decay and the vector part of Λ β-decay may be connected with the partial conservation of the strangeness changing vector current. (auth)

15073 (EFINS-62-5(Rev.)) LOW-ENERGY PION-KAON INTERACTIONS. Richard C. Arnold (Chicago. Univ. Enrico Fermi Inst. for Nuclear Studies and Chicago. Univ.) May 1962. Contract AT(11-1)-264. 27p.

The scattering amplitudes for π-K interaction are calculated with the inclusion of three interaction mechanisms; S-wave pion pair exchange, P-wave pion pair exchange, and the "bootstrap" mechanism of K^* exchange. The contributions are approximated by the exchange of resonant states, which are treated as stable particles for the purpose of estimating their effects. Calculations are carried out using an approximate form of the Chew-Mandelstam N-D elastic scattering formalism as proposed by Feldman, Matthews, and Salam. The coupling of the ρ meson, representing the P-wave pion pair, is derived in terms of the universal coupling hypothesis of Sakurai. The effect of S-wave pion pair exchange is represented by a $T = 0$, $J = 0$ quasi-particle termed the "ABC resonance." Its mass and coupling constant to the pion are chosen to be roughly equivalent to the data of Abashain, which indicate a strong S-wave pion interaction, though not a resonance. Parameters for the ρ meson are taken from the data of Maglic, and experimental data on the K^* resonance made use of from the work of Alston. The coupling constant of the "ABC resonance" to the K may be adjusted to vary the width of the calculated K^* resonance, but only within narrow limits. With a reasonable width for K^* assumed for the crossing contribution, the calculated K^* position is considerably higher and the calculated width is much greater than experimental data indicate. The determining factors for the width are principally kinematical. The effect of a phenomenological high-mass exchange contribution is also considered. Results of the calculations show that if the K^* is essentially created by the elastic "bootstrap" mechanism, the width must be at least 100 Mev to reproduce the experimental position. No resonances other than the $J = 1$, $T = \frac{1}{2}$ (K^*) are produced, although S-wave interactions are strong, and are similar to those which would be induced by bound or ghost S-wave states. (auth)

15074 (EFINS-62-17) REGGE POLES IN RELATIVISTIC SCHRÖDINGER THEORY. Reinhard Oehme (Chicago. Univ. Enrico Fermi Inst. for Nuclear Studies and Chicago. Univ.). Mar. 1962. Contract AT(11-1)-264. 19p.

The Regge trajectories $\alpha(E)$ associated with the scattering of relativistic particles at a Coulomb potential are considered as analytic functions of the energy E. The trajectories for particle and antiparticle scattering are related by a simple crossing relation. In addition to the branch points at $E = \pm m$, the functions $\alpha(E)$ have complex branch points which are related to the possibility of a collapse into the center. Corresponding singularities are expected for a Yukawa potential resulting from a vector meson interaction. The possible relevance of these results for relativistic dispersion theory is discussed. (auth)

15075 (JINR-D-1090) ON CAUSALITY IN MODERN FIELD THEORY. D. I. Blokhintsev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). Sept. 13, 1962. 9p.

The form of causality adopted in modern theory follows from the basic space-time concepts. It was borrowed from macroscopic physics and is automatically applied to infinitely small scales because of the nature of the singularities of the Green functions. This leads to the appearance of divergencies (infinities) for a number of the most important physical quantities associated with elementary particles. Some preliminary theoretical models that modify essentially causality for small space-time scales, retaining at the same time, the macroscopic causality are considered. (auth)

15076 (JINR-P-1019) IZUCHENIE MNOGOCHASTICHNYKH RESONANSOV. (A Study of Many-Particle Resonances). A. A. Belyakov, Yung-chang Wang, V. I. Veksler,

et al. (Joint Inst. for Nuclear Research, Dubna, USSR. Lab. of High Energy). 1962. 21p.

The pion resonances from the reaction accompanied by Λ and K^0 production were studied. An indication to an existence of new resonant states with the effective masses (4π) with M ≅ 1350 Mev, K*** with M ≅ 1650 Mev, K** with M ≅ 1150 Mev, and Y** with M ≅ 1800 Mev was obtained. The existence of the resonances observed at other energies (ρ, ξ, K*, Y*) is also confirmed. It was noticed that the many particle resonances are likely to undergo a cascade decay into other resonant states. (auth)

15077 (JINR-P-1106) OB ANALITICHESKIKH SVOISTVAKH AMPLITUDY FEINMANA I. (On the Analytical Properties of the Feynman Amplitude). I. S. Zlatev and A. V. Nikolov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 40p.

A previously developed Feynman amplitude concept corresponding to an arbitrary tightly bound diagram with negative index was used in an investigation of amplitude singularities. The concept is based on integration of independent internal pulses and on a convenient diagram that in turn is based on a quasi-diagram concept. The concept was used for determining that the number of independent pulses is not less than 3. The so-called resultant forms are not capable of finding the singularities. Further studies are suggested. (tr-auth)

15078 (NP-12565) EXEGESE MATHEMATIQUE DE L'INVARIANCE GLOBALE (FORMALISME DE J. M. SOURIAU). (Mathematical Explanation of Global Invariance (The Formalism of J. M. Souriau)). Daniel Kastler (Paris. Université). 1961. 18p.

An elementary particle model is presented that is based on the concept that the 8 baryons may be considered as the (iso)spinors of the 7 mesons, and that these spinors may be constructed by the use of quaternions. The unimodular orthogonal transformations of the meson charge space R_7 (which space makes a distinction between K and π mesons) constitute a group G that is isomorphic to the product $SU_2 \times SU_2 \times SU_2$ of the group of unitary quaternions; therefore, G is the group of global invariance. These transformations, as well as the transformations they induce in the baryon charge space, can be uniquely constructed by means of quaternion multiplication to the right and to the left. The properties and effects of the global invariance group are described. A review is given of quaternion algebra. (T.F.H.)

15079 (NP-12566) UN MODELE DES COLLISIONS BINAIRES INÉLASTIQUES "PÉRIPHÉRIQUES." (A Model of Peripheral Binary Inelastic Collisions). George Salzman (Paris. Université). 1961. 43p.

A model for high-energy strong peripheral interactions is proposed that is based on the conjecture that if the four-momentum transfer is quite small the pole term dominates the scattering matrix. The possibility of determination of the intensity of the π-π interaction by extrapolation from the physical region to the pole is discussed. Only one-pion exchange is considered. The development is founded on data from π-π, π-N, and N-N interactions. (T.F.H.)

15080 (NP-12567) NEW PARTICLES AND/OR RESONANCES. Jeremy Bernstein (Paris. Universite). [1961]. 43p.

A field-theoretical review is given of the production and properties of high-energy (on the order of 1 Bev) resonances. (T.F.H.)

15081 (NP-12588) RELATIVISTIC TWO-BODY KINEMATICS 2, 3, 5, 7, 10, 15, 20, 30, 45 Bev/c 0° TO 180° IN 15° STEPS. Internal Memorandum. H. C. DeStaebler, Jr. (Stanford Univ., Calif.). Aug. 1961. 95p. (M-274)

The relativistic two-body kinematics for several (γ,p), (γ,d), (π,p), (α,p) reactions were calculated for center of mass angles ranging from 0 to 180° and for incoming momentum values of 2, 3, 5, 7, 10, 15, 20, 30, and 45 Bev/c. Calculations were made with a Burroughs 220 program. (D.C.W.)

15082 (NYO-9289) REGGEIAN ANALYSIS OF DISSIMILAR PARTICLE SCATTERING. Richard E. Cutkosky (Carnegie Inst. of Tech., Pittsburgh). Jan. 1963. Contract AT(30-1)-882. 6p.

A method for extracting information on Regge trajectories from experimental data in the analysis of high-energy, small-angle elastic scattering is outlined. (D.C.W.)

15083 (PAN-366/VII) SYMMETRY PROPERTY OF RELATIVE COORDINATES (OR MOMENTA) IN A SYSTEM OF n IDENTICAL PARTICLES. Marek Grynberg and Ziro Koba (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Oct. 1962. 14p.

Any components of (n-1) relative coordinate (or momenta) vectors of n identical particles are shown to make up bases of (n-1)-dimensional irreducible representation of the permutation group S_n corresponding to the Young diagram. A simple application of this property is presented. (auth)

15084 (PAN-368/VII) ON THE MULTIPERIPHERAL MODEL OF PARTICLE PRODUCTION IN SUPERHIGH ENERGY NUCLEAR COLLISIONS. PART I. Ziro Koba and Andrzej Krzywicki (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Nov. 1962. 23p.

An elementary method of evaluating cross sections of particle production at superhigh energy by the multiperipheral model is presented. It consists in an approximate separation of two competing factors, the product of pion-propagators and that of low energy interactions at vertices. A simplifying approach leads to results similar to the asymptotic solution obtained by Amati and also shows some resemblance to the bremsstrahlung theory. (auth)

15085 (PAN-369/VII) ON THE MULTIPERIPHERAL MODEL OF PARTICLE PRODUCTION IN SUPERHIGH ENERGY NUCLEAR COLLISIONS. PART II. Ziro Koba and Andrzej Krzywicki (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Nov. 1962. 34p.

Applying the elementary method of studying the multiperipheral model, upper bounds for certain partial cross sections of proton-proton collisions at E ≈ 250 Bev are evaluated. The numerical results (based on low energy experimental data) turn out definitely too small compared with the superhigh energy experiments. Possible reasons for this discrepancy are discussed. (auth)

15086 (TID-16474) ELASTIC NUCLEON-DEUTERON SCATTERING. K. L. Kowalski and D. Feldman (Brown Univ., Providence). [1962]. Contract AT(30-1)-2262. 59p.

Some formal and practical problems concerning the effects of the internal target nucleon motion and of the multiple scattering on the elastic scattering of high-energy nucleons by deuterons are considered. In order to provide a foundation for the examination of these effects, two well-known forms of the impulse approximation are studied within the context of a multiple-scattering formalism, and it is found that the form due to Watson appears to be the most convenient and consistent in its application. Some methods for solving the multiple-scattering equations are investigated. The direct use of the optical-model approach

is shown to be impractical for very light nuclei and, in particular, for the deuteron. An alternative means of obtaining solutions of the multiple-scattering equations (when the number of target nucleons is small) which permits the exact treatment of the ground-state scattering while allowing a systematic treatment of the contributions due to the excited intermediate nuclear states is discussed. A practical technique is developed for generating approximate solutions of the two-body integral equations which occur in the various multiple-scattering formalisms. In the study of the consequences of the internal target nucleon motion, the impulse approximation is used to express the complete nucleon-deuteron transition matrix element in terms of two-nucleon transition (t) matrices in the form of integrals over the internal-momentum distribution of the target nucleons; these integrals are then evaluated under the assumption that the principal contribution to the scattering occurs for those values of the relative target nucleon momentum, q, such that $q = zn$, where n is one-half the momentum transfer and $0 \leq z \leq 1$. The variation of the off-the-energy-shell t matrix elements over this range of q is taken into account for the Hamada potential. The integrals are then employed to calculate (in the single-scattering approximation) the cross sections and polarizations for elastic nucleon-deuteron scattering for incident nucleon (lab) energies of 40, 95, and 150 Mev and c-m scattering angles of 30 to 150°. A comparison is made between the present calculation and the results obtained with the customary procedures of either neglecting entirely the q dependence of the t matrices (Chew approximation) or assuming that these matrices depend only linearly on q. At 150 Mev, where the off-the-energy-shell effects are largest, the results are shown to depend significantly on the type of t operator used, especially at large angles. The best fit to the polarization at 150 Mev is obtained with a t operator which corresponds approximately to Watson's form of the impulse approximation. 52 references. (auth)

15087 (TID-17670) INTENSITY MODULATION OF GAMMA RAYS BY MEANS OF MAGNETIC FIELDS. Scientific Paper 62927-11506-P1. R. Zito and L. M. Epstein (Westinghouse Electric Corp. Research Labs., Pittsburgh). Oct. 23, 1962. Contract AT(30-1)-2989. 13p.

A technique for modulating the intensity of a beam of gamma rays without the use of moving parts by taking advantage of the polarization of the resonant 14.4-kev lines of Fe^{57} in a magnetized soft iron source and their interaction with a magnetized absorber of the same material serving as a polarization analyzer, is described. Apparatus is described for the modulation, detection, and demodulation of the appropriate radiation, and data are presented to illustrate the magnitude of the effect. The system is unaffected by the presence of unmodulated gamma rays and may be developed further for use in thickness or density gaging. (auth)

15088 (UCRL-6994) ANGULAR CORRELATION ANALYSIS. D. H. White (California. Univ., Livermore. Lawrence Radiation Lab.). July 12, 1962. Contract W-7405-eng-48. 17p.

An analysis of angular correlation data is described, in which measurements are made at a minimum number of properly chosen angles. The radiation studied is assumed to be beam produced (in particular, a neutron capture-gamma experiment). Calculations are made concerning the "false correlation" and "correlation damping" effects that result from the finite dimensions of the target and detectors, and from the scattering and attenuation of radiation in the target. Explicit expressions for the appropriate corrections are compiled. (auth)

15089 (UCRL-10494) TABLE OF KINETIC ENERGY VS. MAGNETIC RIGIDITY FOR ELECTRONS. F. W. Breivogel and M. D. Holtz (California. Univ., Berkeley. Lawrence Radiation Lab.). Oct. 23, 1962. Contract W-7405-eng-48. 160p.

Values of electron kinetic energies as a function of magnetic rigidity were calculated for $\beta_\rho = 0$ to $\beta_\rho = 26$ kgauss-cm on an IBM computer, using the equation $T = [(8.987567 \cdot 10^{-8})(\beta_\rho)^2 + 0.261127132036]^{\frac{1}{2}} - 511.006$. (D.C.W.)

15090 (UCRL-10615) ON THE NATURAL BOUNDARY OF THE SCATTERING AMPLITUDE (thesis). Jack Wong (California. Univ., Berkeley. Lawrence Radiation Lab.). Dec. 1962. Contract W-7405-eng-48. 53p.

In some current theories of elementary particle interactions, the elastic two-particle scattering amplitude on the second Riemann sheet of $\sqrt{s - 4m^2}$, $\phi^{(2)}(s, \cos\theta)$, possesses singularities dense everywhere on the real negative s-axis for arbitrary complex $\cos\theta$. The real negative s-axis is therefore a natural boundary of $\phi^{(2)}(s, \cos\theta)$ for arbitrary $\cos\theta$, whereas the partial-wave amplitude $\phi_l^{(2)}(s)$ is known not to possess this natural boundary. Inspection of the integral defining $\phi_l^{(2)}(s)$ in terms of $\phi^{(2)}(s, \cos\theta)$ might lead one to expect $\phi_l^{(2)}(s)$ to possess the same singularities as $\phi^{(2)}(s, \cos\theta = \pm 1)$. The integral defining $\phi_l^{(2)}(s)$ is examined carefully, and it is demonstrated here why $\phi_l^{(2)}(s)$ does not possess the "expected" singularities. Mandelstam's representation, partial-wave unitarity relations, and classification of singularities by Liouville series are utilized. (auth)

15091 (AEC-tr-5638) SOURCE OF MONOCHROMATIC GAMMA RADIATION UTILIZING COMPTON SCATTERING. Tokiji Kaminishi. Translated from p.562-6 of "Proceedings of the Fourth Japan Conference on Radioisotopes, held in Tokyo, October 10-12, 1961." 12p. (Includes original, 5p.).

Experimental and theoretical considerations of producing monoenergetic gamma radiation by circular scattering are examined. The source, scattering point, and detecting point are placed on the perimeter of a circle. Very constant energy is obtained in experiments regardless of the scattering point location on the circle perimeter. (D.C.W.)

15092 (NP-tr-949) INELASTIC INTERACTIONS OF THE HIGH-ENERGY PARTICLES IN RENORMALIZED THEORIES OF THE STRONG INTERACTIONS. I. F. Ginzburg (Akademiya Nauk S.S.S.R. Institut Matematiki, Novosibirsk). Translated by E. V. Cherepova from report TF-6. 1962. 18p.

The expansion of Green's functions and differential cross sections of inelastic processes in the power series by reciprocal energy $1/s$ is stated in renormalized theories. In some cases the first terms of such a series are common peripheral diagrams, in the other cases they are more complicated. The field of applicability of the obtained results is always more than in usual "pole-approximation" of the peripheral collisions. (auth)

15093 (NP-tr-950) INVARIANT CHARGE AND REGGE ASYMPTOTIC BEHAVIOR. D. V. Shirkov (Akademiya Nauk S.S.S.R. Institut Matematiki, Novosibirsk). Translated by N. A. Chernova from report TF-8. 1962. 9p.

Procedure of investigating the asymptotic behavior of charge and various asymptotics of high order Green functions by a renormalized group method is treated. Asymptotic behavior of the elastic scattering amplitude for elementary particles is given particular attention, and

derivation of Regge asymptotics from perturbation theory is outlined. (D.C.W.)

15094 PRODUCTION OF A SUPPLEMENTARY PION AND ONE-MESON APPROXIMATION IN THE STATIC PION-NUCLEON MODEL. W. Kummer (Technische Hochschule, Vienna). Acta Phys. Austriaca, 15: 353-61(1962). (In German)

A derivation given by E. Henley and W. Thirring of the Low equation in the Heisenberg reference for elastic pion-nucleon scattering permits a simple application to the case of the production of a supplementary π meson. It gives, however, the same much too small value of previous calculations. It was shown, however, that the validity of the one-meson approximation is superior in the area of the 3-3 resonance. (tr-auth)

15095 INELASTIC SCATTERING OF SLOW NEUTRONS AND THE BEHAVIOUR OF A SINGLE PARTICLE IN THE MANY-PARTICLE SCATTERING SYSTEM. Andrzej Fuliński (Inst. of Nuclear Physics, Kraków). Acta Phys. Polon., 22: 399-407(Nov. 1962). (In English)

The relations between slow neutron scattering data and the dynamical behavior of a single particle in a many-particle scatterer are studied. Using no models, equations describing the momentum and energy relaxation times for single particle in terms of neutron differential cross sections are given. Making use of a model of the behavior of a particle, these equations can serve to determine the potentials of interaction between particles of the scatterer. The non-electronic (phonon) part of the heat conduction of liquid metals can also be determined in this way. (auth)

15096 TWO KINDS OF NEUTRINO. Jerzy Rayski (Jagellonian Univ., Kraków). Acta Phys. Polon., 22: 429 (Nov. 1962). (In English)

A formalism is noted in which the lepton numbers (l) and light-fermion numbers (f) of electrons and muons can be systematized by giving the (f,l) numbers: μ^-, (1,1); e^+, (1,-1); e^-, (-1,1); and μ^+, (-1,-1). It is noted that the existence of two types of neutrinos is consistent with the assignment of the above quantum numbers to the ν_μ, $\tilde{\nu}_e$, ν_e, and $\tilde{\nu}_\mu$, respectively. (T.F.H.)

15097 FERMI ACCELERATION OF CHARGED PARTICLES. Donat G. Wentzel (Univ. of Michigan, Ann Arbor). Astrophys., J., 137: 135-46(Jan. 1963).

Two efficient types of Fermi acceleration by hydromagnetic shocks are presented. One is based on Parker's work on acceleration between shocks that cross each other. An equivalent situation is that of a single shock crossing a closed magnetic line of force. It is shown that a net gain in particle energy occurs even if the shocks are weak. A second type is the acceleration by a shock that moves into stronger magnetic fields. While the particle is accelerated ahead of the shock and is able to penetrate stronger fields, the shock field may become sufficiently stronger that the particle is unable to escape the trap and is accelerated for a long time. No such prolonged trapping occurs for the same particle decelerated behind a similar shock moving into weaker fields, so that the net efficiency of acceleration is high. Conditions on acceleration of thermal particles, specifically electrons, are discussed. One condition is that the particle must move faster than the shock. (auth)

15098 ANGULAR INFORMATION ON NUCLEON-NUCLEON COLLISION AT ULTRARELATIVISTIC ENERGIES. II. DETERMINATION OF THE PRIMARY ENERGY. C. Castagnoli, A. de Marco, and C. Lamborizio. Atti Accad. Sci. Torino. I. Classe Sci. Fis., Mat. Nat., 96: 939-51(1961-62). (In Spanish)

A comparison is made between the various formulas for determining the primary energy of nucleons in interactions at very high energies. After a brief discussion of these methods, the experimental data obtained with 27-Bev protons in nuclear emulsions are reported. From an analysis of the results, it was concluded that the (log $|\cot \vartheta|$) method has noticeable advantages over the other methods. (tr-auth)

15099 NEW CLASSIFICATION OF ELEMENTARY PARTICLES AND RESONANCES. Francis Halbwachs. Compt. Rend., 255: 2724-6(Nov. 19, 1962). (In French)

The recent discovery of a second neutrino and of a resonance K-$\underline{p}$ with strangeness +1 leads to a generalization of the Sakata scheme with respect to the Vigier relativistic rotator theory. (tr-auth)

15100 EVIDENCE OF AN INTERACTION BETWEEN TWO BEAMS PENETRATING EACH OTHER IN A MAGNETIC FIELD. Claude Étiévant and Mario Perulli. Compt. Rend., 255: 2739-41(Nov. 19, 1962). (In French)

A mechanism for the instability in the vicinity of the cyclotron semi-frequency was shown in a system of two electron beams penetrating each other in a magnetic field. This mechanism is different from the classical double beam interaction. It corresponds to the coupling of the slow charge wave of a beam with the fast cyclotron wave of the other beam. The finite geometry makes this coupling possible because the space charge electric field possesses necessarily a radial component. The symmetry of the system leads to the formation of stationary waves. (tr-auth)

15101 THEORY OF ISOBARIC RESONANCES CONSIDERED AS INTERNAL EXCITED STATES OF THE RELATIVISTIC ROTATOR MODEL OF ELEMENTARY PARTICLES. Pierre Hillion and Jean-Pierre Vigier. Compt. Rend., 255: 2908-10(Nov. 26, 1962). (In French)

Completed by the isobar concept, the theory of resonances, outlined previously (Compt. Rend., 255: 2566 (1962)), can be used to analyze the decay modes of elementary particles. (tr-auth)

15102 π^+ P SCATTERING AT THE 3/2 RESONANCE IN THE ISOBARIC MODEL. Gisèle Bordes. Compt. Rend., 256: 612-14(Jan. 14, 1963). (In French)

The parameters for an isobaric model with a variable ray length, which takes into consideration the elastic scattering, were determined. (tr-auth)

15103 CONTRIBUTIONS TO THE THEORY OF THE RADIATIVE FORMATION OF ELECTRON-POSITRON PAIRS ON THE NUCLEUS. N. F. Nelipa (Lebedev Inst. of Physics, Moscow). Dokl. Akad. Nauk SSSR, 148: 68-70 (Jan.-Feb. 1963). (In Russian)

A generalized expression for the radiative pair formation on nuclei by the process γ + nucleus — recoil nucleus + $e^+ + e^- + \gamma'$ was derived by determining the differential cross section of the reaction in the first non-vanishing approximation of the perturbation process. The order of magnitude of the expression is about 1/137 of the pair formation cross section. The expression may be used for calculating the differential cross section. (TTT)

15104 LINEAR POLARIZATION OF $5.12mc^2$ GAMMA RAYS RAYLEIGH SCATTERED FROM K-ELECTRONS IN MERCURY. B. S. Sood (Punjab Univ., Chandigarh, India). Indian J. Physics, 36: 569-72(Nov. 1962).

The linear polarization of $5.12mc^2$ gamma rays Rayleigh-scattered from K electrons in mercury is evaluated by using the amplitudes of scattering obtained from refined numerical and approximate form factor calculations respectively. It is seen that the two calculations predict quite different

percentage polarization at some scattering angles. The contribution of nuclear scattering is taken into account. (auth)

15105 ELECTRON CAPTURE BY ALPHA-PARTICLE PASSING THROUGH HELIUM ATOM. S. C. Mukherjee and N. C. Sil (Indian Assn. for the Cultivation of Science, Jadavpur, Calcutta). Indian J. Phys., 36: 573-6(Nov. 1962).

Expressions for single and double electron capture by an α particle passing through normal helium atoms are derived by applying a variational method. (auth)

15106 PARTICLE STRUCTURE. S. C. Horning (Wallingford, Penn.). Nature, 197: 369(Jan. 26, 1963).

A model of particle structure is presented that is in good numerical agreement with many observations and that is readily expandable to include other observations. (C.H.)

15107 THE QUANTUM MECHANICS OF SPATIALLY EXPANDED ELEMENTARY PARTICLES. Erich Bagge (Institut fur Reine und Angewandte Kernphysik, Kiel). Naturwissenschaften, 49: 534(1962). (In German)

When, in the Hamilton function of a system of elementary particles, the Heisenberg permutation relationship is calculated so that the canonical conjugated pulse and the coordinates are considered as operators, the wave functions $\psi(q_k)$ describe the particles of the systems as spatially expanded particles with the linear dimensions $q_k^{(o)}$. This magnitude represents specifically the complex minimum length characterizing the particle. The expression for the differential scattering cross section in proton-proton collision is derived and numerically evaluated for scattering angles of 15, 30, and 45°. The experimental results can be better explained in the framework of this theory than by pure coulomb scattering of spatially expanded particles. (J.S.R.)

15108 OPTIMUM DESIGN OF EXPERIMENTS ON EXPONENTIAL ABSORPTION WITH n OBSERVATIONS. E. J. Burge (Univ. of London). Nucl. Instr. Methods, 17: 248-56(Dec. 1962). (In English)

A general expression is derived for the statistical error in the absorption coefficient measured in an experiment on exponential absorption with n observations and allowance for background. Two special cases are analyzed, one with equally spaced points and equal weighting on the usual semi-log plot, and the other with equal spacing and equal counting times. For each case, the variations of error, optimum absorber thickness and optimum time for background counting are found for several values of n, (2 to 30), and background (0.001 to 100 times the count rate for no absorber). For a given total time, the error increases with the number of observations for small background, and decreases with n for large background. For $n > 2$ and large background the error is significantly less than that for the ideal design with $n = 2$. The design with equal counting times is simpler to use and leads to smaller errors compared with the one with equally weighted points, but it allows a less searching check on the linearity of the semi-log plot. (auth)

15109 MEASUREMENT OF ENERGY DISTRIBUTIONS OF ^{137}Cs GAMMA RAYS SCATTERED IN WATER. C. Sybesma (University Hospital, Leiden). Nucl. Instr. Methods, 21: 167-8(Jan. 1963). (In English)

Continuous energy distributions resulting from scattering of Cs^{137} gamma rays in a cylindrical water medium were observed by means of a gamma spectrometer. A NaI(Tl)-activated crystal was used to detect pulse height spectra produced by radiation from a point source in a cylindrical water medium. The pulse height spectra were corrected for the limited resolution of the detector and for the escape effects in the detector. In this correction care was taken to avoid oversimplifications and mathematically unjustified approximations. The results were compared with data calculated according to the "moment method" by Goldstein and Wilkins and with data from comparable experiments by Theus et al. This comparison shows that approximations usually applied can lead to incorrect results. (auth)

15110 ON THE SPIN ANGULAR MOMENTUM OF THE DIRAC PARTICLE. J. Hilgevoord and S. A. Wouthuysen (Univ. of Amsterdam). Nucl. Phys., 40: 1-12(Jan. 1963). (In English)

A covariant splitting of the total angular momentum of a spin-$\frac{1}{2}$ particle into an orbital and a spin part is obtained by treating the Dirac equation as a subsidiary condition for the solutions of the Klein-Gordon equation of a spinor field. The so obtained conserved spin tensor is the analog of a classically defined spin tensor. (auth)

15111 STATISTICAL ANALYSIS OF MESON JETS. E. M. Friedlaender (Inst. of Atomic Physics, Bucharest). Nucl. Phys., 40: 18-23(Jan. 1963). (In English)

In order to distinguish "two-center-like" emission from emission from two independent centers, a method is proposed that is based upon the fluctuations of several convenient functions constructed from the angular distribution of meson jets. A numerical example favoring true two-center emission is discussed. (auth)

15112 WEAK RADIATIVE DECAYS OF HYPERONS. A. P. Contogouris and How-sen Wong (Cornell Univ., Ithaca, N. Y.). Nucl. Phys., 40: 34-43(Jan. 1963). (In English)

The radiative decays of Σ^+ and Λ are studied in terms of dispersion relation techniques. For this study, the absorptive part of the decay amplitudes is calculated in the approximation of keeping only the one-pion one-nucleon intermediate states. The contribution of the (πN-γN) vertex is expressed in terms of the $J = \frac{1}{2}$ partial wave amplitudes for pion photoproduction on nucleons; that of the (hyperon-πN) vertex arises as the solution of an integral equation, and involves integrals over the s- and p-wave $J = \frac{1}{2}$ phase shifts for pion-nucleon scattering. With certain simplifications concerning the main contributions to the pion photoproduction on protons and the asymptotic behavior of the π-N phase shifts, the ratio $\rho \equiv (\Sigma^+ \to p + \gamma)/(\Sigma^+ \to p + \pi^0)$ is calculated assuming the validity of the $|\Delta T| = \frac{1}{2}$ rule and time reversal invariance. It is found that, if the intermediate state in $\Sigma^+ \to n + \pi^+ \to p + \gamma$ is a pure s-wave, the ratio $\rho \approx 0.6\%$, is in good agreement with experimental data; if the state is a pure p-wave, ρ is estimated to be smaller by an order of magnitude. (auth)

15113 STUDY OF THE PION PHOTOPRODUCTION PROCESS ON THE BASIS OF DISPERSION RELATIONS. A. M. Baldin and A. I. Lebedev (Lebedev Inst. of Physics, Moscow). Nucl. Phys., 40: 44-53(Jan. 1963). (In English)

The experimental data on the $\gamma + p \to p + \pi^0$ and $\gamma + p \to n + \pi^+$ processes in the near threshold γ energy region are analyzed on the basis of dispersion relations. When calculating the dispersion integrals, use is made of experimental data on the absorption part of the photoproduction amplitude. Agreement with the predictions of dispersion relations is obtained for the photoproduction of π^0 mesons. The $\gamma + d \to d + \pi^0$ and $\gamma + d \to p + p + \pi^-$ processes are discussed for the analysis of the isobaric structure of the photoproduction amplitude, as well as for the elucidation of the role of the π-π interaction. (auth)

15114 ON SCATTERING OF SLOW NEUTRONS IN A FERMI LIQUID. A. I. Akhiezer (Khar'kov Inst. of Physics and Tech.), I. A. Akhiezer, and I. Ya. Pomeranchuk. Nucl. Phys., 40: 139-57(Jan. 1963). (In English)

Slow neutron scattering in a Fermi liquid is studied theoretically. If the change of neutron momentum and energy during scattering is much less than the cut-off momentum and cut-off energy of the Fermi liquid, specific Fermi-liquid effects appear in scattering. If the neutron velocity exceeds the zero-sound velocity, neutrons may excite zero-sound oscillations in scattering. For such scattering there is a unique connection between the energy and momentum transferred, in contrast to direct scattering accompanied by the departure of the Fermi-liquid quasi-particle out of the filled Fermi sphere. This result enables the two types of scattering to be distinguished, in principle. The cross section for direct scattering and scattering with zero-sound excitation as well as the coefficient of neutron depolarization and the coefficient of neutron reflection off the Fermi liquid surface are determined. At grazing incidence the reflection coefficient has sharp maxima corresponding to zero-sound excitation. (auth)

15115 FORM-FACTORS FOR THE AXIAL VECTOR n-p CURRENT. V. S. Mathur, R. P. Saxena, and Ravinder Nath (Univ. of Delhi). Nucl. Phys., 40: 158-61(Jan. 1963). (In English)

The form factors for the axial vector n-p current are investigated. The strong renormalization effects are shown to arise directly from the pion pole. The resulting current is in agreement with experiment. (auth)

15116 FINAL STATE INTERACTION AND CP INVARIANCE IN RADIATIVE $K_{\pi 2}$ DECAY. H. Chew (Univ. of Chicago). Nuovo Cimento (10), 26: 1109-27(Dec. 16, 1962). (EFINS-60-70) (In English)

The effect of an I = 1, J = 1 pion-pion resonance on the matrix element of the decay $K \rightarrow 2\pi + \gamma$ is studied. It is found that while the matrix element strongly favors low photon frequencies as a result of the final state interaction, the observable effects are much reduced by the phase-space factor. These effects are probably observable only in K_2^0 decay. The usual final-state interaction theorem is found to be invalid in general because of the existence of a radiative rescattering channel. The use of partial wave dispersion relations is briefly discussed. Some selection rules for the photon states in K_2^0 decay are derived on the basis of CP invariance. The branching ratio $R(K_2^0 \rightarrow 2\pi + 2e)/R(K_2^0 \rightarrow 2\pi + \gamma)$ is calculated for various values of the π-π resonance parameters. The correlation of the electron and the pion planes is calculated. (auth)

15117 THE INFLUENCE OF K* AND PION RESONANCES AND HYPERON PARITIES ON K-NUCLEON SCATTERING. E. M. Ferreira, C. G. de Oliveira, and P. P. Srivastava (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Nuovo Cimento (10), 26: 1128-43(Dec. 16, 1962). (In English)

K-nucleon scattering is assumed to be due to the set of processes in which intermediate states consisting of the vector meson resonances play important roles. These processes are evaluated using straightforward perturbation methods. Comparing the results with the experimental data available for both I = 1 and I = 0 isotopic spin states it is found that the only combination of parities of hyperons for which agreement with experiment is possible is that given by $P(\Lambda K N) = P(\Sigma K N) = -1$, the coupling constants being $g_\Lambda^2 \simeq 5$ and $g_\Sigma^2 \simeq 2.3$. The two-pion isovector resonance is found to give negligible contribution to the scattering, while the exchange of the three-pion isoscalar resonance plays an important role. The contributions of the fourth-order diagrams involving the K* resonance to the scattering in both isotopic spin states are strong and attractive. (auth)

15118 ON THE COUPLING CONSTANT IN THE PRESENCE OF AN UNSTABLE PARTICLE. Z. Bialynicka-Birula (Inst. of Physics, Polish Academy of Sciences, Warsaw). Nuovo Cimento (10), 26: 1197-1204 (Dec. 16, 1962). (In English)

Two simple models of quantum field theory, describing the interaction of an unstable particle with two stable ones, are solved. Following PEIERLS, it was assumed that the propagator of an unstable particle has a complex pole on the second Riemann sheet. A definition of the coupling constant is proposed which allows the coupling constant to be expressed in terms of masses and the lifetime of an unstable particle. (auth)

15119 ON THE GROWTH AND DECAY OF ELECTRON-PHOTON SHOWERS IN MATERIALS OF HIGH ATOMIC NUMBER. Siddheshwar Lal and A. Subramanian (Tata Inst. of Fundamental Research, Bombay). Nuovo Cimento (10), 26: 1245-53(Dec. 16, 1962). (In English)

The growth and decay of electron-photon showers in the energy region of about (0.2-1) Bev in brass and lead were studied using multiplate cloud chamber photographs. This reveals the inadequacy of existing theoretical treatment of the processes involved. In the case of brass, agreement exists up to the shower maximum which is lacking in the case of lead. However, the observed shower curves in lead seem to agree with Monte Carlo calculations. The absorption mean-free-path of the shower secondaries after the maxima are 1.25 ± 0.25 and 3.2 ± 0.2 radiation lengths in the case of brass and lead respectively. The number of particles, N_{max}, at the maximum of the shower scale have primary energy according to the relation $N_{max} \propto E_0^n$, n being ~0.8 in the energy region 0.2 to 1 Bev in both brass and lead. (auth)

15120 ON THE RELATIVISTIC EFFECTS IN LOW-ENERGY PION-NUCLEON SCATTERING. M. Carrassi (Università, Genoa and Istituto Nazionale di Fisica Nucleare, Genoa) and G. Passatore. Nuovo Cimento (10), 26: 1254-78(Dec. 16, 1962). (In English)

The parts of the S and P amplitudes for the pion-nucleon scattering which in the Cini-Fubini approach do not depend on the pion-pion interaction are evaluated in a relativistic way. The self-consistency of the approximate theory used here is discussed on the basis of the integral equation for the resonance. This discussion shows that the theoretical results are affected by some uncertainty which however does not prevent definite predictions on the contribution of the pion-pion interaction. This contribution, although somewhat reduced with respect to that expected in the nonrelativistic approximation, is nevertheless required in order to fit the experimental data. The results obtained for the S-wave show the possibility of a quantitative determination of the contribution of the pion-pion interaction. (auth)

15121 REGGE POLES AND ELASTIC SCATTERING AT HIGH ENERGIES. G. Domokos (Joint Inst. for Nuclear Research, Dubna, USSR). Nuovo Cimento (10), 26: 1301-8 (Dec. 16, 1962). (In English)

Consequences of an asymptote of the Regge type on high-energy elastic scattering are investigated. Relations between total cross sections of various processes are obtained. It is shown that the imaginary part of the vacuum pole is a positive definite function. An approximate analytic expression is derived for the vacuum trajectory. (auth)

15122 POSITIVE PHOTOPION PRODUCTION FROM HYDROGEN USING A PROPANE BUBBLE CHAMBER.

J. M. Scarr, W. T. Morton, and I. S. Hughes (Univ. of Glasgow). Nuovo Cimento (10), 26: 1315-19(Dec. 16, 1962). (In English)

A propane bubble chamber, with a tube through its center containing high pressure hydrogen gas, was used to measure the cross section for the production of positive pions from protons by γ rays with an energy between 165 and 212 Mev. In the usual notation, the value of the parameter a_0^+ was found to be 12.9 ± 2.1, 13.7 ± 1.4, 13.6 ± 1.8, 14.0 ± 2.1, 13.0 ± 2.9 in units of 10^{-30} cm^2/sr, at γ energies of 169.5, 178, 187, 196.5, and 206.5 Mev, respectively. (auth)

15123 MOTION OF A PARTICLE WITH SPIN IN A NONHOMOGENEOUS ELECTROMAGNETIC FIELD. A. I. Solomon (Inst. for Advanced Studies, Dublin). Nuovo Cimento (10), 26: 1320-4(Dec. 16, 1962). (In English)

The relativistic equations of motion for a charged particle with arbitrary spin in a nonhomogeneous electromagnetic field are derived from the classical equations and, for the case of a spin-½ particle, from Takabayasi's hydrodynamical formulation of the Dirac equation. (auth)

15124 ON PION-NUCLEON DIFFRACTION SCATTERING. S. Bergia and J. N. Chahoud (Università, Bologna and Istituto Nazionale di Fisica Nucleare, Bologna). Nuovo Cimento (10), 26: 1354-67(Dec. 16, 1962). (In English)

The strip approximation to the Mandelstam representation is applied to π^- + p diffraction scattering at low energies. The equivalence, to a certain extent, with the peripheral model is shown. Production cross sections are evaluated in terms of low energy pion-pion scattering. The results for the diffraction pattern are compared with the experimental data. (auth)

15125 PROTON-PROTON INTERACTION AT 560 Mev. B. Baldoni (Università, Bologna and Istituto Nazionale di Fisica Nucleare, Bologna), S. Focardi, H. Hromadnik, L. Monari, F. Saporetti, S. Feminò, F. Mezzanares, E. Bertolini, and G. Gialanella. Nuovo Cimento (10), 26: 1376-88(Dec. 16, 1962). (In English)

Results are given on the proton-proton interaction at 560 Mev. The experiment was performed at CERN using a hydrogen bubble chamber. The experimental results show evidence for the pion-nucleon and proton-neutron final state interactions. (auth)

15126 SOME REMARKS ON $K_{2\pi}^+$ AND K_{e4}^+ DECAYS. K. Chadan and F. M. Renard (Laboratoire de Physique Théorique et Hautes Energies, Orsay, France). Nuovo Cimento (10), 26: 1405-6(Dec. 16, 1962). (In English)

The effects of ζ-resonance and 2π-resonance on the decay mode K_{e4}^+ were studied. The contributions of ζ-resonance to the decay rate of the K meson were very small. The spectrum of electrons in the $K_{2\pi}^+$ depended strongly on the interaction between the two pions. (C.E.S.)

15127 ON THE SINGULARITY AT VANISHING COUPLING CONSTANT. T. Yoshimura (Instituto de Asuntos Nucleares, Bogota). Nuovo Cimento (10), 26: 1407-8 (Dec. 16, 1962). (In English)

The assumption that quantities such as scattering amplitudes would be analytic in the coupling constants at vanishing values was shown to be invalid by means of a divergence-free model. The correction factors of the one-body propagators at the high momentum energy limit have singularities at vanishing coupling constant but of a type different from that of superconductivity. (C.E.S.)

15128 PION-PROTON SCATTERING AT 600 Mev. R. Barloutaud, L. Cardin, A. Derem, C. Gensollen, A. Levêque, C. Louedec, J. Meyer, and D. Tycho (Centre d'Etudes Nucleaire, Saclay, France). Nuovo Cimento (10), 26: 1409-11(Dec. 16, 1962). (In English)

A π^+-p scattering experiment was performed at 600 Mev incident pion kinetic energy with the 35 cm hydrogen bubble chamber. The total elastic and inelastic cross sections were determined by comparing the number of elastic and inelastic events and using a value for the total cross section. (C.E.S.)

15129 REGGE POLES AND ELASTIC SCATTERING OF ALPHA PARTICLES BY CARBON. L. Rebolia and G. A. Viano (Universita, Geneva). Nuovo Cimento (10), 26: 1426-8(Dec. 16, 1962). (In English)

The cross sections of elastic backward scattering for the $C^{12}(\alpha,\alpha)C^{12}$ process were fitted to a formula for well-known nuclear processes. A single-level formula was given for the experimental resonance points. A pole-trajectory connecting the different resonances was not found. (C.E.S.)

15130 THE $\Sigma \rightarrow \Lambda + e + \nu$ DECAY AS A TEST OF THE CONSERVED VECTOR CURRENT HYPOTHESIS. W. Alles (Universita, Bologna and Istituto Nazionale di Fisica Nucleare, Bologna). Nuovo Cimento (10), 26: 1429-33(Dec. 16, 1962). (In English)

Several tests were given to distinguish between the vector current and the axial current. A mathematical method was developed to show that only one of these currents contributes to the $\Sigma \rightarrow \Lambda + e + \nu$ decay. It was shown that the vector current was responsible for this decay. (C.E.S.)

15131 METRIC FIELDS. IV. BARYON MESON MASS SPECTRUM. P. Sen (National Physical Lab., New Delhi, India). Nuovo Cimento (10), 27: 575-88(Feb. 1, 1963). (In English)

When the quantum field, in the field-metric theory, is separated into its space-time and internal co-ordinate parts it is shown: that the wave equations of the space-time part of the field are the established local wave equations; that free field wave equations describe the internal co-ordinate field whose quantum numbers are already determined; that the elementary particle selection rules are obtained from these quantum numbers; and that the baryon-meson mass spectrum can also be obtained from them. Then for non-relativistic but physical boundary conditions two models are constructed according to two possible interpretations of the observed baryon-meson mass spectrum. The mass spectra obtained from these models are given. Both are in agreement with the observed mass spectrum. Then it is indicated that the most characteristic feature of the non-local theories considered is the existence of sequences of resonances. Estimates of succeeding resonances for the fermion-isofermion, fermion-isoboson, boson-isoboson, and boson-isofermion fields are predicted for the two models. (auth)

15132 POINT SLITS VERSUS LINEAR SLITS IN THE ANGULAR CORRELATION OF POSITRON ANNIHILATION RADIATION. P. Colombino, B. Fiscella, and L. Trossi (Università, Turin and Istituto Nazionale di Fisica Nucleare, Turin). Nuovo Cimento (10), 27: 589-600(Feb. 1, 1963). (In English)

An experimental apparatus is used to study the angular distribution of γ rays from positron annihilation. The coincidence counting rate $N_z(p_z)$ is proportional to a linear integral of the momentum density function, while with another experimental set up it is proportional to a double integral. The results of measurements carried out on various oriented samples of graphite are discussed. (auth)

15133 POSSIBLE RELATIONSHIPS BETWEEN THE K-NUCLEON INTERACTIONS AND THE HYPERONIC RES-

ONANT STATES. F. Ferrari, F. Paccanoni, and M. Pusterla (Università, Padua; Università, Bari; and Istituto Nazionale di Fisica Nucleare, Padua). Nuovo Cimento (10), 27: 612-26(Feb. 1, 1963). (In English)

The $\bar{K}$-proton scattering amplitudes are investigated, represented by phenomenological parameters, the longest range forces arising from the exchange of resonating pion systems between the $\bar{K}$ meson and the nucleon and between the pion and the hyperon. The possible relationships between the $\bar{K}$-nucleon interactions and the Y* resonant states are discussed. (auth)

15134 MULTIPLE MESON PRODUCTION IN ANTI-PROTON-PROTON ANNIHILATION. Q. A. M. M. Yahya (Imperial Coll., London). Nuovo Cimento (10), 27: 627-35(Feb. 1, 1963). (In English)

Experiments on $\bar{p}$-p annihilation indicate an excess of π^- over π^+ in $\bar{p}$-direction (forward) and an equal excess of π^+ in p-direction (backward). Also, the experimental results on the distribution of angle between like pion pairs and unlike pion pairs differ significantly from that in the statistical model. To accommodate these effects, the emission of some free mesons from the clouds of proton and antiproton is considered, along with a statistical model for the annihilation of cores with angular momentum conservation and pion-pion resonance. The model reproduces the experimental results. (auth)

15135 HYPERFRAGMENT PRODUCTION BY 4.5 Gev/c π^--MESON INTERACTIONS IN EMULSION NUCLEI. A REAPPRAISAL. J. Zakrzewski (Univ. of Warsaw), D. H. Davis, and O. Skjeggestad. Nuovo Cimento (10), 27: 652-9 (Feb. 1, 1963). (In English)

The hyperfragment production by fast π meson interactions is shown to be explainable in terms of a given model. In particular, the short-range hyperfragments are shown to be predominantly very heavy, and not light. Certain conclusions are critically examined with recourse to this result. (auth)

15136 THE ALMOST CONSERVED CURRENT HYPOTHESIS AND PSEUDO-SCALAR MESON THEORY. W. M. Frank, W. S. Hellman, and G. H. Mullen (Naval Ordnance Lab., Silver Spring, Md.). Nuovo Cimento (10), 27: 660-7(Feb. 1, 1963). (In English)

The extent to which PS(PS) (PS ≡ pseudoscalar) meson theory is compatible with the almost-conserved-current hypothesis is examined. It is shown that a well-behaved almost-conserved axial current cannot be constructed for PS(PS) theory. Nonlocal almost-conserved currents are introduced that appear to satisfy the almost-conserved-current hypothesis, for matrix elements not diagonal in the energy momentum. (auth)

15137 INELASTIC π^--p INTERACTIONS AT 7 Gev. G. Bozoki, E. Fenyves, A. Frenkel, and E. Gombosi (Central Research Inst. of Physics, Budapest). Nuovo Cimento (10), 27: 668-73(Feb. 1, 1963). (In English)

The angular distribution of pions observed in two-prong π^--p interactions in emulsion was investigated. It is shown that π^- mesons observed in interactions of the type $\pi^- + p \rightarrow p + \pi^- + k\pi^0$ (k = 1,2, ...) were collimated forward in the π-π center-of-mass system. This result indicated that a certain fraction of the observed events corresponded to elastic π-π-scattering having diffraction character. (auth)

15138 PION-KAON RESONANCE. P. Cazzola (Università, Padua). Nuovo Cimento (10), 27: 718-23(Feb. 1, 1963). (In English)

The π-K scattering is considered in a phenomenological way, in the frame of the Mandelstam representation. The possibility of a low-energy resonance is discussed for the $p(I = 1/2)$ wave, in the assumption of a large I = J = 1 resonance in the annihilation channel $\pi + \pi \rightarrow K + \bar{K}$. (auth)

15139 INTERPRETATION OF PION-NUCLEON SCATTERING RESULTS IN THE RESONANCE REGION. W. M. Layson (CERN, Geneva). Nuovo Cimento (10), 27: 724-47 (Feb. 1, 1963). (In English)

Recognizing that information on pion-nucleon scattering in the range (300 to 1500) Mev is insufficient for a complete and unambigous analysis in terms of angular-momentum amplitudes, a study is made employing restrictive assumptions related to the higher resonances. The π^-p angular distribution data are found consistent with resonances of $(T,J) = (1/2,3/2^-)$ and $(1/2,5/2^+)$ at 600 and 900 Mev respectively. A plausible, but nonunique, set of amplitudes is determined, and the only significant departure from a simple behavior is in the amplitude for the $(1/2,1/2^+)$ state, which could contain a resonance at 900 Mev. The Λ^0K^0 production cross section shows features in agreement with such a resonance. A proposed phenomenological model based on the role of the $(3/2,3/2^+)$ pion-nucleon state predicts the existence of eight resonances below 1500 Mev. Experimental results are compared with the model and suggestions are made regarding possible tests. (auth)

15140 THE NUCLEON ELECTROMAGNETIC MASS DIFFERENCE. A. I. Solomon (Inst. for Advanced Studies, Dublin). Nuovo Cimento (10), 27: 748-50(Feb. 1, 1963). (In English)

The proton-neutron electromagnetic mass difference is calculated from expressions for the nucleon charge and magnetic form factors obtained from the experimental curves. (auth)

15141 TWO NEUTRINOS OR ONE? S. A. Bludman (Univ. of Pennsylvania, Philadelphia). Nuovo Cimento (10), 27: 751-60(Feb. 1, 1963). (UCRL-10449) (In English)

The value is discussed, in the light of "two-neutrino" experiments, of giving meaning to the neutrino charge or lepton number independent of helicity (i.e., of giving up the two-component neutrino theory and reverting to a single four-component neutrino, whose left- and right-helicity states are coupled to e^- and μ^+ respectively). It is shown that, in fact, only by such experiments, involving muons and electrons or their neutrinos, can a nontrivial meaning be given to lepton conservation. This Dirac neutrino theory is compared with the conventional theory of two two-component neutrinos from the conceptual and experimental points of view. Remarks are made about the possibility of explaining the $\mu - e$ mass difference. (auth)

15142 THE BP-3 HEAVY LIQUID CHAMBER: EXAMPLES OF PHYSICS EXPERIMENTS. M. Bloch (Ecole Polytechnique, Paris). Onde Elec., 41: 994-1000(Dec. 1961). (In French)

Two experiments made with this chamber — one at Saclay and the other at CERN — are described in some detail. The electron decay of the Λ_0 hyperon was the first study. The experimental apparatus for the production of the π^- meson, the selection of the liquid measure in the chamber, and the photographic study are described. The results obtained for the electron decay are in sharp disagreement with the theoretical predictions, but the implications of this disagreement are not considered. The experimental devices used in the study of the detection of high energy neutrinos (an investigation which is in process and not yet completed) are then described. (J.S.R.)

15143 THE LIQUID HYDROGEN BUBBLE CHAMBER CBH-81: EXPERIMENTS AT CERN. B. Gregory (Ecole

Polytechnique, Paris). Onde Elec., 41: 1034-41(Dec. 1961). (In French)

The characteristics of a liquid hydrogen bubble chamber as they are viewed by a physicist using the negatives are reviewed very briefly. Two experiments made at CERN—one on the interaction of antiprotons created by the accelerator on the protons of the liquid hydrogen and the other on the study of the interaction of π^- mesons of very high energy (10 Bev) with the hydrogen—are summarized. Typical photographs obtained are shown. (J.S.R.)

15144 ON THE THREE-PARTICLE SCATTERING OPERATOR IN CLASSICAL GASES. J. Weinstock (National Bureau of Standards, Washington, D. C.). Phys. Letters, 3: 260-2(Feb. 1, 1963). (In English)

The Green function form of the three particle scattering operator is shown to be associated with a binary collision expansion that readily yields the "irreducible" character of the operator. The form is also shown to be capable of describing the non-equilibrium behavior of systems by the time dependence of the general n-particle collision operators of which the scattering operators are simply an asymptotic limit. (D.C.W.)

15145 ON THE STRUCTURE OF THE VACUUM TRAJECTORY. D. V. Shirkov (Inst. for Mathematics, Academy of Sciences, Novosibirsk, USSR). Phys. Letters, 3: 273-4 (Feb. 1, 1963). (In English)

A discussion of the use of the renormalization group method to determine vacuum trajectory elements leads to the conclusion that all interactions in the high energy region are of equal importance and that the real trajectory $\alpha(t)$ must have cuts beginning at $t = 0, 4m_e^2, 16m_e^2, 4m_\mu^2, 4m_\pi^2, \ldots$. (D.C.W.)

15146 A RESTRICTED CLASS OF EXACT EIGENSTATES OF THE PAIRING-FORCE HAMILTONIAN. R. W. Richardson (Univ. of Michigan, Ann Arbor). Phys. Letters, 3: 277-9(Feb. 1, 1963). (In English)

The existence of a restricted class of eigenstates of the pairing-force hamiltonian that contains N pairs of particles and which are natural generalizations of those states containing one pair is shown by using a method that is easier than direct diagonalization of the hamiltonian. (D.C.W.)

15147 A CORRECTION TO THE CALCULATED ENERGIES OF 2p–1s μ-MESONIC X-RAYS. F. J. Bloore (National Research Council, Ottawa), Y. P. Varshni, and J. M. Pearson. Phys. Letters, 3: 303-4(Feb. 1, 1963). (In English)

The effect of using denser charge distributions in theoretical calculations of the energy of x rays emitted during 2p–1s transitions in μ mesons is examined. The denser distributions seem to largely resolve discrepancies between earlier experimental and theoretical results. (D.C.W.)

15148 THE MAGNETIC MOMENT OF THE PROTON. I. THE VALUE IN NUCLEAR MAGNETONS. J. H. Sanders and K. C. Turberfield (Oxford Univ.). Proc. Roy. Soc. (London), Ser. A. 272: 79-102(Feb. 19, 1963).

The magnetic moment of the proton is measured in nuclear magnetons by comparing the proton spin resonance frequency with the proton cyclotron frequency in the same magnetic field. A consistent theory of the motion of the ions in the modified decelerating cyclotron used for measuring the cyclotron frequency is developed in order to interpret the experimental results. Deceleration of protons by means of a decelerating potential at eight and sixteen times their cyclotron frequency, and of H_2^+ ions at sixteen times their cyclotron frequency were observed. The result, related to the spin resonance frequency of the free proton, is that the magnetic moment of the proton is 2.79277 ± 0.00005 nuclear magnetons. (auth)

15149 THE MAGNETIC MOMENT OF THE PROTON. II. THE VALUE IN BOHR MAGNETONS. J. H. Sanders, K. F. Tittel, and J. F. Ward (Oxford Univ.). Proc. Roy. Soc. (London), Ser. A, 272: 103-18(Feb. 19, 1963).

The magnetic moment of the proton is measured in Bohr magnetons by comparing the proton spin-resonance frequency with the electron cyclotron frequency in the same magnetic field. The electron cyclotron signal is observed as an absorption of energy from a radio-frequency field in a cavity. Particular attention is paid to the elimination of effects that might alter the electron cyclotron frequency from the true value. The result, related to the spin-resonance frequency of the free proton, is that the magnetic moment of the proton is $(1.521043 \pm 0.000006) \times 10^{-4}$ Bohr magneton. (auth)

15150 THE TWO-NUCLEON INTERACTION. B. P. Nigam (Univ. of Buffalo). Rev. Mod. Phys., 35: 117-29 (Jan. 1963).

Use of phase shift analysis, the s-matrix approach, phenomenological two-nucleon potentials, meson theoretic potentials, and Mandestam representation in treatment of two-nucleon interactions is reviewed. Procedure for obtaining necessary scattering parameters is also outlined. (D.C.W.)

15151 THE MEASURING PROCESS IN QUANTUM THEORY. J. M. Burgers (Univ. of Maryland, College Park). Rev. Mod. Phys., 35: 145-50(Jan. 1963).

Von Neumann's finding that the outcome of a measuring process is independent of the description of the measuring apparatus effect is examined in terms of quantum theory by using two methods for calculating the outcome of an interaction of a system of particles with the measuring systems. The results obtained are equivalent. (D.C.W.)

15152 EXPERIMENTAL POSSIBILITY WITH CROSSED ELECTRON AND POSITRON BEAMS. Raffaele Raoul Gatto (Universitâ, Cagliari, Frascati, Italy). Ric. Sci., (2), 2: 161-72(July 1962). (In Italian)

Five possible experimental studies, using crossed electron and positron beams, are briefly indicated. These are: possible proof of the validity of high-energy electrodynamics, production of particles with strong interaction and study of the electromagnetic form factor for transfer of time pulses, resonance study, verification of the particle character with strong interaction in electrodynamics, and production of vector mesons. (J.S.R.)

15153 THE TWO-NEUTRINO EXPERIMENT. Leon M. Lederman. Sci. Am., 208: No. 3, 60-70(Mar. 1963).

An experiment carried out with the 30-Bev accelerator at the Brookhaven National Laboratories has demonstrated that there is not one variety of the particle known as the neutrino but two. The proof was ultimately supplied by a long series of detailed experiments, climaxed by the direct observation of neutrino-induced reactions. The historical background for the experiment is related, and the description is accompanied by several drawings and photographs. (C.E.S.)

15154 CHARGED PARTICLES. L. A. Frank, J. A. Van Allen, and H. K. Hills (Univ. of Iowa, Iowa City). Science, 139: 905-7(Mar. 8, 1963).

There is a complete absence of charged particles associated with the planet Venus at radial distances as small as 41,000 km on the sunward side of the planet. This result is taken to mean that the magnetosphere of Venus, if any, does not extend to that great a distance. The most plausible

interpretation is that $(M_V/M_E) \leq 0.18$, where M_V and M_E are the dipole magnetic moments of Venus and Earth, respectively. The results are consistent with $M_V/M_E = 0$. Certain qualifications prevent this interpretation from being a definitive one. (auth)

15155 THE INTERACTION OF ELECTRONS AND POSITRONS AT HIGH ENERGIES. V. N. Baier. Usp. Fiz. Nauk, 78: 619-52(Dec. 1962). (In Russian)

The structure and methods of describing strong interactions are not considered satisfactory, since the mass, spin and other characteristics of the elementary particles cannot be calculated. It is believed that further progress in the theory can be made by finding the limits of applicability of the classical theory of electrodynamics. Hence, experiments between colliding beams of 500-Mev electrons, or between high-energy electrons and positrons, are important in detecting deviations which will advance the theory. Methods of producing and storing positrons in a synchrotron arrangement are reviewed. Calculations showed that the conversion of 500-Mev μ-electrons to positrons is 5%, and that the positron beam can be stored for 48 hours in a vacuum of 4×10^{-10} mm Hg std. The corrections to the electrodynamic cross section due to radiative losses are explained. Methods of detecting expected deviations are elucidated. The creation of new particles by collision of electron and positron beams, and the investigation of the structure of these particles are distinct possibilities, if the mass is less than the beam energies, and if the life time is 10^{-9} to 10^{-10} seconds. The existence of strongly interacting particles can be confirmed by anomalies in the cross sections of other processes and by threshold effects. The life time and electromagnetic form factor of the π^0-meson can be followed by the reaction $e^+ + e^- \rightarrow \pi^0 + \gamma$, which has a threshold of 70 Mev. The form factor of the muon can be investigated by the reaction $e^+ + e^- \rightarrow \mu^+ + \mu^-$. Similarly, form factors and possible unstable intermediates can be studied for pions, K-mesons and hyperons. A number of important properties of elementary reactions could thus be determined by direct experimentation. 109 references. (TTT)

15156 INELASTIC INTERACTION OF PROTONS WITH PHOTOEMULSION NUCLEI. G. A. Tleubergenova and P. V. Morozova. Vestn. Akad. Nauk Kaz. SSR, No. 3, 72-76(1962).

Using a proton beam from the synchrocyclotron of the Joint Institute of Nuclear Research at Dubna, nuclear disintegrations in a photoemulsion were investigated. The stars were analyzed with respect to number and density of the tracks. With 9-Bev protons 79 disintegrations of light nuclei and 890 of heavy nuclei were discovered. These results, including the angular distribution, agreed well with the values measured by V. S. Barashenkov, V. A. Belyakov, Wang-Shu Fen et al. (The interaction mechanism of fast protons with nucleons and nuclei, R-331, Dubna, 1959). Only with protons of more than 5 Bev can total nuclear disintegration be achieved. According to Zh. S. Takibayev, this may be related to the generation and following annihilation of antinucleons. For a primary energy < 9 Bev the secondary charged fast particles formed, whose energy is 3.5 ± 0.5 Bev, caused 34 disintegrations of light nuclei of of total of 409. As the multiplicity of generation of secondary charged particles gradually increased when the proton energy is increased to < 9 Bev, cascade mechanism is suggested. Along with this effect the contribution of slow charged particles (E < 30 Mev) to the intranuclear process falls off. There are 5 tables and 8 references. (OTS)

15157 INTRODUCTION A LA NOUVELLE THÉORIE DES PARTICULES DE M. JEAN-PIERRE VIGIER ET DE SES COLLABORATEURS. (Introduction to a New Theory of Particles of Jean-Pierre Vigier and His Collaborators). Louis de Broglies. Paris, Gauthier-Villars & Cie, 1961. 125p.

The new theory of particles recently developed by Vigier and his collaborators is explained, following the same very simple reasoning given by the developers of the theory at the beginning of their studies. In order to make the new classification correspond with the old theory of particles with spin, the idea of spin unities and the possibility of their symmetrical and antisymmetrical combinations corresponding respectively to central components of the triplets and to singlets was introduced in the Vigier theory. (J.S.R.)

Neutron Physics

15158 (AEEW-M-286) MONTE CARLO CALCULATIONS OF FAST EFFECTS IN URANIUM GRAPHITE LATTICES. J. E. Beardwood and J. G. Tyror (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Dec. 1962. 16p.

Results are presented concerning a series of computations of fast neutron effects in natural U metal/graphite cells. The computations were performed using the Monte Carlo code SPEC. It is shown that neutron capture in U^{238} is conveniently discussed in terms of a capture escape probability (ξ) as well as the conventional probability p. The latter is associated with the slowing down flux and has the classical exponential dependence on fuel-to-moderator volume ratio while the former is identified with the component of neutron flux above 1/E. (auth)

15159 (AEEW-R-212) STANDARD CURVES AND FORMULAE FOR NEUTRON KINETICS CALCULATIONS. M. N. John (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Oct. 1962. 28p.

The response of the neutron kinetic equations to a wide range of step and ramp additions of reactivity has been evaluated on the PACE 231R analogue computer for two fuels, U^{235} and Pu^{239}, with a full range of neutron lifetimes. The results are presented in the form of standard curves that may be readily used to assess the "zero-energy" performance of a reactor at the early stages of a reactor concept. Appendices contain the derivation of several useful expressions associated with neutron kinetics calculations and demonstrate the use of the curves to estimate reactor behavior during shut-down following trip action. (auth)

15160 (BNL-719(Vols.I,II,III, and IV)) PROCEEDINGS OF THE BROOKHAVEN CONFERENCE ON NEUTRON THERMALIZATION, APRIL 30 TO MAY 2, 1962. VOLUME I. THE SCATTERING LAW. VOLUME II. NEUTRON SPECTRA IN LATTICES AND INFINITE MEDIA. VOLUME III. EXPERIMENTAL ASPECTS OF TRANSIENT AND ASYMPTOTIC PHENOMENA. VOLUME IV. THEORETICAL ASPECTS OF TRANSIENT AND ASYMPTOTIC PHENOMENA. (Brookhaven National Lab., Upton, N. Y.). Contract [AT(30-2)-Gen-16]. 1568p.

Included in the conference proceedings are 69 papers grouped into the categories on the experimental and theoretical aspects of the "scattering law," of spectra in lattices and infinite media, and of transient and asymp-

totic phenomena. One paper in each of the categories is a summary of the material presented by the other papers in that group. Separate abstracts have been prepared for 52 papers, and 15 papers have been previously abstracted in NSA. (M.P.G.)

15161 (BNL-719(Vol.I)(p.26-53)) THE SCATTERING LAW FOR LIGHT AND HEAVY WATER AT 20°C AND 150°C. B. C. Haywood and I. M. Thorson (Atomic Energy of Canada Ltd., Chalk River, Ont.).

The thermal neutron scattering laws for both light and heavy water at 20 and 150°C were measured using the phased-rotor neutron velocity selector and time of flight apparatus at the Chalk River NRU reactor. The experimental results are reported, and an initial estimate of Egelstaff's $p(\beta)$ function for use in the calculation of a complete scattering law for reactor physics purposes is derived. (auth)

15162 (BNL-719(Vol.I)(p.54-65)) SOME REMARKS ON THE EXPERIMENTAL INFORMATION NECESSARY TO OBTAIN SCATTERING DATA FOR DIFFUSION PROBLEMS. T. Springer (Munich. Technische Hochschule).

Methods of determining a scattering law $S(K,\omega)$ from experimental data are reviewed. A method is recommended which fits a simplified function $S(K,\omega)$ directly to experimental quantities which can be accurately determined by simple procedures. Experimental and theoretical values of the scattering cross section of water are compared, and some discrepancies are explained. (M.P.G.)

15163 (BNL-719(Vol.I)(p.69-99)) SLOW NEUTRON SCATTERING AND THERMALIZATION BY BENZENE AND OTHER POLYPHENYLS. V. C. Boffi, V. C. Molinari, and D. E. Parks (General Atomic Div. General Dynamics Corp., San Diego, Calif.). (GA-3024)

The general features of neutron scattering by heavy organic molecules are discussed. Those aspects of the molecular motions which are significant for understanding in detail the thermalization of neutrons in such moderators are brought into focus. In addition, the relation between the scattering and the molecular motions is formulated in such a way as to give this relation a form suitable for numerical calculations. The general basis and physical assumptions which are appropriate for a realistic discussion of neutron thermalization by the heavy organic molecules are presented. This general basis is reduced to a form which allows a direct evaluation of the neutron energy transfer cross section to be made in terms of the state of the chemical binding of the hydrogen in the hydrocarbons. Those aspects of the molecular motions of the organic compounds which are significant for understanding the scattering of thermal neutrons are discussed. In particular, the normal mode frequencies of benzene and the normal mode amplitudes are presented. A calculation of the neutron spectrum in a benzene moderator is given, and the effects of chemical binding are displayed by comparing this spectrum with the ones obtained in the case of moderation by a free proton gas and by H_2O. The spectrum in benzene is significantly harder than spectra in either free hydrogen or H_2O. (auth)

15164 (BNL-719(Vol.I)(p.100-16)) CALCULATION OF THERMAL NEUTRON FLUX SPECTRA IN AN INFINITE POLYETHYLENE MODERATED MEDIUM WITH VARYING AMOUNTS OF ABSORPTION. D. T. Goldman and F. D. Federighi ([Knolls Atomic Power Lab., Schenectady, N. Y.]). (TID-15412)

The scattering of thermal energy neutrons by polyethylene was calculated. The scattering from the polyethylene system was treated as that from a group of harmonically bound oscillators whose normal mode frequencies have been determined by an analysis of spectroscopic data. Thus, it was possible to compare the total scattering cross section with measured results to arrive at some basis for empirically determining the validity of the model. The differential scattering cross section was used in a program which calculates infinite media spectra. The results of the calculations are compared with experimental data for various amounts of poison material. The agreement between theory and experimental results was sufficiently satisfactory to permit the use of the polyethylene scattering cross section in the analysis of reactor experiments with reasonable confidence. (auth)

15165 (BNL-719(Vol.I)(p.117-20)) THERMAL NEUTRON SCATTERING IN GRAPHITE. L. S. Kothari (Delhi. Univ.).

The relaxation time for the slowing down of neutrons near thermal equilibrium and the mean energy loss per collision are calculated, using various assumptions, and compared to experimental values. The average diffusion constant, $\bar{D}_0$, and the diffusion cooling constant, C, are also evaluated and compared to experimental results. Methods for calculating C are briefly discussed. (M.P.G.)

15166 (BNL-719(Vol.I)(p.121-43)) APPLICATION OF SCATTERING LAW DATA TO THE CALCULATION OF THERMAL NEUTRON SPECTRA. J. D. Macdougall (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England and United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Establishment, Winfrith, Dorset, England).

The method of using the data from the scattering law experiments at Chalk River in calculations of reactor thermal neutron spectra is discussed, and some comparisons of calculated and measured spectra for a Calder Hall lattice are presented. In the experiments at Chalk River the differential scattering cross-section $\sigma(E \rightarrow E', \theta)$ for scattering from energy E to energy E′ through angle θ is measured. This data may be reduced to a scattering law $S(\alpha,\beta)$ which is a function of two variables only, basically the momentum and energy transfers. The range of the scattering law which is measured does not include all the energy and momentum transfers required for spectrum calculations and some method of extrapolating and interpolating the data is required. The available experimental data and the method of extending this to all required energy and momentum transfers is discussed. The Fortran program LEAP for calculating the scattering law from the generalized frequency spectrum is described. The nuclear data required for multigroup spectrum calculations are discussed. In particular, methods of group-averaging are discussed and the program PIXSE which produces multigroup cross-sections from the scattering law, primarily for use with the Winfrith DSN program, is described. A brief description of the Winfrith DSN program is given. This is a Fortran program solving the one-dimensional multigroup transport equation in Carlson's discrete S_n approximation, and is at present working in cylindrical geometry. The program incorporates several improvements on Carlson's DSN code, in particular acceleration of convergence by a group selection technique and a different method of solving the reflected boundary condition. The results of applying the above techniques to a particular reactor system are given. The thermal neutron spectrum in a Calder Hall lattice cell is calculated, and a comparison is made with some experimental spectra obtained using a

neutron chopper. Finally, accuracy is discussed. Topics covered are accuracies required in scattering, absorption and fission cross-sections, in group-averaging procedures, and in numerical techniques. These topics are considered in relation to both criticality and temperature coefficient determinations. (auth)

15167 (BNL-719(Vol.I)(p.144-71)) CALCULATION OF DIFFERENTIAL SCATTERING CROSS SECTIONS FOR SLOW NEUTRONS. H. L. McMurry (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho).

As an approach to developing methods for calculating differential scattering cross sections of materials for neutrons with energy below 1 ev, five approximations to the exact formalism of Zemach and Glauber were applied to treat the scattering by gases composed of semi-rigid molecules. The theoretical bases for the five following methods are outlined. (1) A quite rigorous method valid when the neutron energy and k_BT are both much less than the characteristic vibrational energies of the molecules. (2) A method which treats vibrations harmonically, rotations classically, and neglects rotation-vibration coupling. Within these limitations the method is valid at all neutron energies. (3) A method like (2) except that averages over orientation are approximated by the Krieger-Nelkin method of introducing average values of functions of the Eulerian angles wherever they appear. (4) A method which treats vibrations with characteristic energies much less than the neutron energy by a short collision time approximation. (5) A method which treats such low energy vibrations classically. Method (5) has the feature that when all normal modes are treated classically the equation for the differential scattering cross section reduces to that for scattering by unbound particles. If some, but not all, vibrations are treated classically and averages over orientation are approximated as in method (3) the effective mass for a scattering atom attached to the molecule is intermediate between the mass of the atom and the Sachs-Teller mass which applies when all vibrations are treated exactly by quantum mechanics. Method (5) has the advantage of being easily adapted to treating simple models for liquids and amorphous solids. (auth)

15168 (BNL-719(Vol.I)(p.172-202)) EVALUATION OF TECHNIQUES FOR COMPUTING DIFFERENTIAL SCATTERING CROSS SECTIONS. H. L. McMurray, L. J. Gannon, and W. A. Hestir (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho).

Methods for computing partial differential scattering cross sections are evaluated by comparing calculated results with experimental results for methane and propane, and by comparing results on a hypothetical OH molecule of the more approximate methods with the most rigorous ones. The method which treats rotations quantum mechanically gives good agreement with experiments on methane and can be considered as rigorous. The method which treats rotations classically, vibrations by quantum mechanics, and averages over orientation exactly also agrees well with methane experiments, except for scattering at forward angles and low neutron energies where the energy exchanges are comparable to the rotational level spacings. It is used as a standard of comparison for calculations on the OH molecule. The Krieger-Nelkin method, which averages over orientation by inserting average values of functions of the Eulerian angles wherever they appear, works very well at low neutron energies. Calculations on OH show that when the characteristic vibrational energy is high, but much lower than the incident neutron energy, the K.N. method breaks down. The short collision time method of treating low energy vibrations is impractical because too many terms in the required series expansion are needed to give good results. The method which treats low energy vibrations classically gives good results when the characteristic vibrational energies are low, and is better than the K.N. when the characteristic energy is high, but much lower than the neutron energy. (auth)

15169 (BNL-719(Vol.I)(p.203-37)) NEUTRON THERMALIZATION IN A CRYSTALLINE MEDIUM IN INCOHERENT APPROXIMATION. S. N. Purohit (Brookhaven National Lab., Upton, N. Y.).

Placzek's mass expansion formalism is used to obtain energy transfer moments, their associated integrals, and the matrix elements of the scattering operator corresponding to a set of polynomials of energy variables. For a heavy crystal, these quantities are given by single integrals involving the frequency distribution of vibrational modes which can be easily evaluated. Expressions for the thermalization parameters (the diffusion cooling coefficient, the thermalization time constant, the diffusion length, the rethermalization area, and the "neutron temperature") are given in terms of M_2, the second energy transfer moment weighted by the Maxwellian distribution. The variation of M_2 with the frequency distribution of vibrational modes is discussed. A comparative study is presented of M_2 as a function of θ/T_0 (ratio of Debye to thermodynamic temperatures) for Debye and Einstein models and the "Detailed Balance Doppler approximation" for a heavy crystal. Numerical results for the first two energy transfer moments for a heavy Debye crystal for various values of θ/T_0 are presented and discussed. Numerical results for the associated integrals are also given. (M.P.G.)

15170 (BNL-719(Vol.I)(p.276-88)) COMPARISON OF "CLASSICAL" AND "QUASI-CLASSICAL" CROSS SECTIONS FOR SOME SIMPLE SYSTEMS. M. Rosenbaum and P. F. Zweifel (Michigan. Univ., Ann Arbor).

An expression for the differential neutron scattering cross section is derived. Cross sections calculated by this expression for scattering by simple models are compared to cross sections calculated by taking the Fourier transform of the classical correlation function. (M.P.G.)

15171 (BNL-719(Vol.I)(p.289-310)) "HINDERED ROTATIONS" IN LIQUIDS AND SLOW-NEUTRON SCATTERING. S. Yip and R. K. Osborn (Michigan. Univ., Ann Arbor).

A quasi-crystalline model which describes both free and hindered rotations is proposed for the study of polar molecules in the liquid state. By means of the coupling between molecular dipole moment and a local electric field, which represents orientation-dependent effects of intermolecular interaction, hinderance in the rotational motion of a molecule is produced. Under the condition of strong field, oscillator-like solutions are obtained for symmetric and linear molecules. Differential neutron scattering cross sections are calculated, and the effects of hindered and free rotations discussed. When free rotations are ignored, a simple expression suitable for practical applications is given. (auth)

15172 (BNL-719(Vol. II)(p.305-17)) MEASUREMENTS OF SPATIAL AND SPECTRAL DISTRIBUTIONS OF THERMAL NEUTRONS IN HEAVY WATER, NATURAL URANIUM LATTICES. P. Brown, I. Kaplan, A. E. Profio, and T. J. Thompson (Massachusetts Inst. of Tech., Cambridge).

Measurements of the spatial distributions of thermal

neutrons in natural-U-D_2O-moderated lattices were made with gold, lutetium, and europium foils. The experimental distributions were compared to those calculated with the THERMOS Code, which assumes a cylindrical cell centered on the fuel rod and computes the spatial and spectral thermal neutron distribution for various epithermal cutoffs. The experimental techniques are described. Experimental results show that the thermal neutron density can be computed to a high degree of accuracy. The Au foil distributions showed the best agreement between theory and experiment. Lu^{176} was found to be a better detector than Eu^{151}, since it is more sensitive to changes in the thermal neutron spectrum and does not require an involved correction for epicadmium activity. (M.P.G.)

15173 (BNL-719(Vol.II)(p.318-36)) OBSERVATION OF HARDENED NEUTRON SPECTRA IN WATER AND BORIC ACID SOLUTIONS. K. Burkart and W. Reichardt (Kernforschungszentrum. Institut für Neutronenphysik und Reaktortechnik, Karlsruhe, Germany).

Neutron spectra in water and boric acid solutions were observed by the time-of-flight method and by lutetium foil techniques. Both methods yield results in good agreement. They show a stronger hardening than those obtained by previous authors. The agreement with the predictions of the Nelkin model is satisfactory. (auth)

15174 (BNL-719(Vol.II)(p.337-58)) INTEGRAL SPECTRUM MEASUREMENTS IN HETEROGENEOUS MEDIA. Thomas F. Parkinson and Sagid Salah (Florida. Univ., Gainesville).

Experiments are described which were performed to obtain enough data to evaluate various methods for reactor calculations. Activation detectors of Lu, Au, Mn, and Dy were used to obtain integral spectrum measurements. The experimental techniques and methods for analyzing the data are discussed. Results are presented in tables and graphs for traverses through a one-inch stainless steel rod centered in the UFTR thermal column, through a U slab in the UFTR, through 3- and 4-U-rod clusters, through the UFTR core, and through the Stanford Pool Reactor core. (M.P.G.)

15175 (BNL-719(Vol.II)(p.359-400)) LOW ENERGY NEUTRON SPECTRA IN THE ZENITH HEATED GRAPHITE MODERATED REACTOR. F. R. Barclay, M. S. Coates, K. M. Diment, S. A. Durrani, D. B. Gayther, H. H. Pitcher, and M. J. Poole (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

Time-of-flight spectra were measured as an experimental check on the various scattering models used in calculations. Spectrum measurements were made on a collimated beam emerging from the top surface of a half-length fuel element positioned at the center of the core and close to the core side-reflector boundary. Measurements were made for core and side-reflector temperatures ranging from 20 to 650°C. The principles of time-of-flight measurements using a chopper and the design of the experiment are discussed. The spectra obtained from core-center and core-edge positions are shown in graphs. Detailed comparisons of the cold spectra with theoretically calculated spectra are made, and reaction rates for various detectors are compared with calculated values. It was found that the model of room-temperature graphite due to Egelstaff and Schofield could be used for normal spectrum calculations. (M.P.G.)

15176 (BNL-719(Vol.II)(p.401-10)) INTEGRAL NEUTRON SPECTRA MEASUREMENTS NEAR A CADMIUM DISK. P. Korpiun, K. Renz, and T. Springer (Munich. Technische Hochschule).

Eu-Cu and Eu-Lu foil pairs were used to measure the changes in the neutron spectrum near a cadmium disk. The foils, mounted on polystyrene disks within a polystyrene cylinder, were exposed in the water reflector of the FRM reactor. The activation ratios as a function of the distance from the absorbing disk are shown in graphical form. Curves of effective neutron temperature as a function of distance from the absorbing disk are also presented, and the uncertainties involved in the calculation of effective neutron temperatures are discussed. (M.P.G.)

15177 (BNL-719(Vol.II)(p.411-36)) MEASUREMENT OF NEUTRON SPECTRA IN URANIUM–WATER AND URANIUM–MONO ISOPROPYL DIPHENYL LATTICES. V. I. Mostovoĭ, V. S. Dikarev, M. B. Egiazarov, and Yu. S. Saltykov.

Experiments are reported in which the space-energy distribution of neutrons in heterogeneous U-water and U-$C_{15}H_{16}$ lattices is measured. The experimental set up is described, including subcritical assembly, neutron source, cavities in the assembly to bring out neutron microbeams, collimator, chopper, BF_3 detector, and transit time analyzer. The results are presented in graphs and discussed in detail. (M.P.G.)

15178 (BNL-719(Vol.II)(p.RD1-34)) THERMAL NEUTRON SPECTRA IN HETEROGENEOUS ASSEMBLIES. Henry C. Honeck (Brookhaven National Lab., Upton, N. Y.).

The techniques used to compute thermal neutron spectra in heterogeneous media are reviewed. Equations are not derived nor, in most cases, are they even stated. Rather, the approximations that lead to each method are described in words, and an overall picture of the methods that are actually used and their relationship to one another are given. (auth)

15179 (BNL-719(Vol.II)(p.439-63)) SOME MATHEMATICAL AND PHYSICAL REMARKS ON NEUTRON THERMALIZATION IN INFINITE HOMOGENEOUS SYSTEMS. M. Cadilhac, J. Horowitz, J. L. Soulé, and O. Tretiakoff (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay).

The general mathematical properties of the thermalization operator are discussed in order to exhibit its important properties for the behavior of the neutron spectrum at high and low energies. A model is presented for the calculation of any spectrum in infinite homogeneous systems. This model leads to a second order differential equation. Hydrogen and heavy gas are included in this general model. The adjustment of model parameters on experimental data is discussed. (auth)

15180 (BNL-719(Vol.II)(p.464-84)) INTEGRAL AND NUMERICAL TREATMENTS OF THE NEUTRON TRANSPORT PROBLEM. G. Ronald Dalton (Florida. Univ., Gainesville).

The neutron transport equation is derived in one differential form and three integral forms. It is shown that the integral forms are inherently more accurate than the differential form. Consideration of the calculation of the flux depression caused by a highly absorbing foil placed in a thermal neutron flux in a diffusing medium shows that the zeroth spherical harmonic form of an integral form of the neutron transport equation gives results which can be obtained only with much higher order spherical harmonic approximations to the differential form of the same equation. (M.P.G.)

15181 (BNL-719(Vol.II)(p.565-9)) USE OF THE SPM EQUATION FOR NEUTRON THERMALIZATION CALCULATIONS. Carl N. Klahr (Fundamental Methods Associates, New York).

The SPM equation is a second order partial differential equation in neutron space and energy variables which is elliptic in character. The application of this equation to the solution of neutron thermalization problems with multiregion or miltitemperature geometries is described. The same differential equation applies to the thermal, epithermal, and high-energy ranges with different cross sections in each range. Numerical methods are available for solving the SPM equation using experimental cross-section input data. The spatial variation of neutron spectra in a medium of varying composition or temperature can thereby be obtained. (M.P.G.)

15182 (BNL-719(Vol.II)(p.570-91)) UP SCATTERING THERMALIZATION OF NEUTRONS. M. D. Kostin (Harvard Univ., Cambridge, Mass.).

The Wigner-Wilkins integral equation describing the interaction of neutrons with a thermalizing medium, whose atoms are in motion with a Maxwellian-velocity distribution, is used to investigate the neutron spectrum generated by a neutron source in the thermal or subthermal region. For very-high-energy neutrons ($E \gg kT$) this equation is reduced to a simpler one, the up-scattering equation, which resembles the well known $T = 0$ slowing-down equation. The transformation from the slowing-down equation to the up-scattering equation by means of the principle of detailed balance is shown. The very-high-energy up-scattering equation is used to obtain the leading term in the series solution for the neutron density in the high-energy region when the source is in the thermal region. A new form of the Wigner-Wilkins integral equation is presented, from which some addition terms in the series are easily obtained. The extension of this work to include binding effects by performing a double expansion in delta-function derivatives using Wick's expansion is briefly discussed. A method for obtaining approximate slowing-down thermalization solutions applicable to the high-energy region and most of the thermal region for the weak-absorption case is also outlined. (auth)

15183 (BNL-719(Vol.II)(p.592-609)) CALCULATION OF THERMAL SPECTRA IN LATTICE CELLS. D. C. Leslie (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). (AEEW-M-211)

The methods normally used in reactor-physics calculations either ignore altogether the spatial dependence of the thermal spectrum in a lattice cell or grossly oversimplify it. This approach is not satisfactory for interpreting experiments, and it is dubious for design work on reactors containing two moderators at widely differing temperatures, such as the heavy-water-moderated organic-cooled OCDRE. The most obvious method of studying the spatial variation of thermal spectrum is to use a multigroup transport code with no restrictions on the energy transfer matrix. The Carlson SNG program is suitable for this work and a description of its use, together with some results that were obtained are given. This method is laborious and expensive in machine time, and a method known as SPECTROX was developed in parallel with this work. The SPECTROX method is based on a collision-probability treatment of the flux in the fuel, and it leads to a pair of simultaneous energy-dependent equations, which determine the mean flux in the fuel and in the moderator. The theory of this method, the computer programs that were written to exploit it, and some results that were obtained with it are described. It appears to give adequate accuracy for the thermal spectrum in normal systems. (auth)

15184 (BNL-719(Vol.II)(p.610-13)) RADIAL DEPENDENCE OF THE BUMP WHERE THE MAXWELLIAN MEETS THE 1/E-TAIL. R. M. Pearce and J. M. Kennedy.

It is predicted that the bump, as defined by subtracting the best-fitting Maxwellian component from the neutron spectrum, does not exist inside the fuel of a reactor. The results of calculations of the thermal spectrum in a lattice cell of CANDU, a D_2O-cooled and moderated, UO_2-fueled reactor, are discussed. The bump was found to be well defined at the cell boundary, smaller at the oxide-cluster surface, and almost zero inside the fuel cluster. This radial dependence is explained. (M.P.G.)

15185 (BNL-719(Vol.II)(p.614-55)) CHEMICAL BINDING EFFECTS IN THE GENERALIZED HEAVY FREE GAS APPROXIMATION. G. W. Schaefer and K. Allsopp (English Electric Co., Ltd. Atomic Power Div., Whetstone, Leics, England).

It is shown that the integral-Boltzmann-scattering operator may be replaced by a second-order-differential operator of the heavy-free-gas (Wilkins) form by letting $\xi\Sigma_s$ be an arbitrary function of energy. This variable is determined by the moderating properties of a medium, but it also depends on the solution of each particular problem. However, it is shown that, for a wide class of reactor problems, the variable is insensitive to the problem. In these cases it may be obtained simply from the neutron "scattering law" at high and low energies. For heavy moderators, this is true to a good approximation at all energies. Some properties of this generalized equation are discussed. Criteria are derived for deciding which problems may be solved by this theory. Then the sensitivity of slowing down spectra, of thermal reactivity ηf and its temperature coefficients, and of eigenvalues to the "scattering law" is studied and illustrated. Theoretical values of $\xi\Sigma_s(E)$, calculated from various scattering models of graphite and water, are compared with experimentally deduced values. (auth)

15186 (BNL-719(Vol.II)(p.656-65)) ON THE ASYMPTOTIC THERMAL NEUTRON SPECTRUM IN GRAPHITE. Charles S. Shapiro (Brookhaven National Lab., Upton, N. Y.).

The flux was calculated, using Corngold's asymptotic expansion, with the Debye, Krumhansl-Brooks, and free-gas models for the phonon frequency distribution in graphite. The results are in good agreement with experimental values and are displayed in graphs. Use of the Krumhansl-Brooks model gives slightly better agreement than the Debye model. (M.P.G.)

15187 (BNL-719(Vol.II)(p.666-84)) THERMAL NEUTRON SPECTRUM IN A MEDIUM WITH TWO DIFFERENT TEMPERATURES. Hiroshi Takahashi (European Atomic Energy Community. Nuclear Research Center, Ispra, Italy).

The energy dependent equation in the heavy gas model with the first order correction of μ is considered for the case of a non-absorbing homogeneously mixed medium. In the heavy gas approximation, the distribution of the neutron spectrum is the Maxwellian distribution. If the mass ratio μ approaches 1, the distribution deviates from the Maxwellian distribution. By means of the perturbation method, the expression for the deviated flux distribution is obtained. The more rigorous calculation is carried out by expanding the flux in terms of Laguerre polynomials of first order of energy. The generating functions for the matrix element of scattering kernel expanded by the Laguerre polynomials, whose variable E is normalized by a temperature other than the components' temperature,

are calculated for the free gas and the crystalline material. The results obtained from the above two methods show that when the moderator components have the same mass, the neutron spectra are shifted to lower energy than the Maxwellian distribution calculated by the heavy gas approximation. (auth)

15188 (BNL-719(Vol.II)(p.684-705) SIMPLE EXPANSIONS FOR THERMAL NEUTRON FLUX AND IMPORTANCE IN A CYLINDRICAL CELL. E. U. Vaughan (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.).

Neutron thermalization in a lattice of parallel cylindrical fuel rods is studied by means of diffusion theory, using the heavy-gas model of thermalization. The derived expressions are applicable to reactors having metallic fuel, graphite or heavy-water moderator, and heavy-water or liquid-metal coolant. A variational expression is set up for the thermal multiplication factor, and various approximate solutions related to it are considered, including solutions for the case of constant fuel blackness and the case of constant moderator absorption. (M.P.G.)

15189 (BNL-719(Vol.II)(p.706-97)) METHODS OF CALCULATING SLOW-NEUTRON SPECTRA. G. I. Marchuk, V. G. Turchin, V. V. Smelov, and G. A. Il'yasova.

A method for computing the differential scattering cross sections of slow neutrons is derived, taking crystalline effects and chemical bonds into account. Tables of the differential cross sections for the scattering of neutrons by beryllium, graphite, and water are presented. The main problems entailed in the calculation of slow-neutron spectra are formulated, starting with the simplest P_1 approximation and the many-group representation of the fundamental neutron diffusion equations. The P_1 approximation is not sufficiently accurate for cells of a heterogeneous reactor, and a higher-approximation method is described using spherical harmonics. The methods developed are used in calculations of slow-neutron spectra in homogeneous and heterogeneous media. The results of calculations of the slow-neutron spectra in infinite volumes of Be, graphite, and H_2O and in heterogeneous cells are presented in graphs, and the integral group neutron fluxes as functions of the absorber capture cross section are reported in tables. Satisfactory agreement was found between theoretical and experimental values. Another method is developed for determining the diffusion of slow neutrons in inhomogeneous media using certain effective constants determined from experiments. (M.P.G.)

15190 (BNL-719(Vol.III)(p.RE1-62)) TRANSIENT EFFECTS IN SPACE, TIME, AND ENERGY. K. H. Beckurts (Kernforschungszentrum, Karlsruhe, Germany).

A review of 16 papers submitted to the Brookhaven Conference on Neutron Thermalization and dealing with the experimental aspects of "asymptotics" or "transients" in space, time, and energy is given. Most of the papers deal with diffusion parameter measurements using pulsed or stationary methods. Numerous data are reported and are critically compared. A number of new techniques for the investigation of space- and time-dependent thermalization phenomena are reviewed. (auth)

15191 (BNL-719(Vol.III)(p.799-804)) MEASUREMENT OF THE DIFFUSION LENGTH OF THERMAL NEUTRON IN LIGHT WATER. W. C. Ballowe (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.).

An experiment is described, in which the diffusion length in light water of thermal neutrons from a thermal column is measured. The results are presented in graphical form and compared to experimental values from experiments using a point source of low energy neutrons and a pulsed neutron source. Theoretical results for thermal columns and pulsed neutron sources are also included. (M.P.G.)

15192 (BNL-719(Vol.III)(p.805-37)) THERMALISATION OF NEUTRONS IN GRAPHITE. E. Barnard, N. A. Khan, M. J. Poole, J. H. Tait, and R. C. F. McLatchie (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

Experiments are described which measure the spectrum of neutrons in a graphite block at times ranging from 300 to 1000 μsec after the introduction of a fast neutron pulse. The results are compared to theoretical spectra calculated using the scattering kernel for graphite deduced by Egelstaff and the heavy gas model with an "effective mass" of 12 and 33. Reasonable agreement is obtained using the Egelstaff scattering law except for the 1000 μsec spectrum. (M.P.G.)

15193 (BNL-719(Vol.III)(p.879-99)) NEUTRON THERMALIZATION STUDIES AT SAVANNAH RIVER. H. Dean Brown and E. J. Hennelly (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.).

Recent experimental work on neutron thermalization at Savannah River has centered on the thermal neutron diffusion coefficient in D_2O as a function of temperature and on neutron spectra in D_2O lattices. The diffusion coefficient measurements were made by poisoning techniques in the Pressurized Subcritical Experiment (PSE) at temperatures up to 220°C. Excellent agreement was obtained with theoretical predictions. In addition an analysis of all the earlier room-temperature measurements in terms of more recent cross sections and spectral hardening corrections brought the old and new results into agreement, within experimental errors. Spectrum measurements have dealt both with high-temperature lattices and with flux hardening in heavy fuel assemblies. As an example of the latter case, foil activation measurements were made in lattices of 3-inch-dia U metal rods containing 3 wt % U^{235} at a triangular pitch of 18 inches in D_2O. Similar measurements were made at temperatures up to 215°C for lattices of 2-inch-dia U metal tubes in D_2O. Extensive use was made of the THERMOS code for analysis. (auth)

15194 (BNL-719(Vol.III)(p.900-31)) FLUX TRANSIENTS NEAR MEDIUM DISCONTINUITIES. F. Feiner, S. Weinstein, and W. B. Wright (Knolls Atomic Power Lab., Schenectady, N. Y.). (TID-15234)

Experiments are described in which measurements were performed in an assembly of simple geometry to provide data on the variation of neutron flux near the interface between material regions of considerably different nuclear properties. The experimental set up and the characteristics of the lattices studied are described in detail. Measurements were made by activating small foils of fuel, manganese, indium, and gold. From the data obtained, it is possible to determine the peaking or flux depression near or at the medium boundary and the shape of the spatial transient. The experimental results are compared to a space-independent spectrum model and a space-dependent or $\gamma(E)$ model, which uses the experimental observations that the transients are characterized by a single exponential and that their characteristic length depends on the nature of the perturbation. Good agreement with experiment was obtained with the $\gamma(E)$ model. (M.P.G.)

15195 (BNL-719(Vol.III)(p.932-4)) LARGE DELAY TIMES OBSERVED IN ESTABLISHMENT OF SINGLE MODE DECAY IN WATER MODERATORS. Fred Holzer and Marshall F. Crouch (Case Inst. of Tech., Cleveland).

The mean lifetime of thermal neutrons in a large cylindrical moderator was measured. The fundamental mode of the neutron density distribution was synthesized by a network of sources, so that higher modes would not be excited. Although it was expected that a simple exponential decay would be observed after ~10 μsec, it did not start until after ~35 μsec. Several possible explanations for this are briefly discussed. (M.P.G.)

15196 (BNL-719(Vol.III)(p.935-45)) PULSED NEUTRON MEASUREMENTS ON GRAPHITE. H. Klose, M. Kuechle, and W. Reichardt (Kernforschungszentrum. Institut für Neutronenphysik und Reaktortechnik, Karlsruhe, Germany).

The α vs B^2 curve for graphite was carefully measured. Lifetimes were observed on 45 different blocks with B^2 ranging from 7×10^{-4} to 240×10^{-4} cm^{-2}. The results are compared with all previous measurements on graphite. The validity of the power series expansion of α (B^2) is discussed. (auth)

15197 (BNL-719(Vol.III)(p.946-65)) COMPARISON OF DIFFUSION PARAMETERS OBTAINED FOR WATER BY THE PULSED AND THE POISONING TECHNIQUES. J. U. Koppel and W. M. Lopez (General Atomic Div. General Dynamics Corp., San Diego, Calif.). (GA-3085)

The relation between the measurement of neutron decay times in pulsed assemblies of decreasing size and the measurement of diffusion lengths in media of increasing poison concentration is discussed. The results of recent measurements of Σ_a, the infinite medium diffusion constant D_0, and the diffusion cooling constant C for water obtained by pulsed and poisoning methods are compared. Both methods appear to be suitable for measuring Σ_a and D_0. A large discrepancy was found in the values for C, and possible sources of the discrepancy are discussed. (M.P.G.)

15198 (BNL-719(Vol.III)(p.966-76)) THE TIME SCALE OF NEUTRON SLOWING DOWN IN WATER. E. Moeller (Aktiebolaget Atomenergi, Stockholm) and N. G. Sjoestrand (Chalmers Tekniska Hogskola, Göteborg).

The time scale of neutron slowing-down in water was studied using the pulsed beam of the van de Graaff accelerator at Studsvik for the production of neutron bursts in the moderator. The moderation process is followed by the measurement of the neutron capture rate in nondisturbing amounts of cadmium and gadolinium dissolved in the water, the time resolution being one-tenth the resolution in earlier studies. With both elements a thermalization time constant of about 4 μsec was found. (auth)

15199 (BNL-719(Vol.III)(p.981-96)) EXPERIMENTAL INVESTIGATION OF PERSISTING CHANGES IN THE THERMAL NEUTRON DECAY CONSTANT IN FINITE MEDIA OF ICE AND BERYLLIUM AS A FUNCTION OF TEMPERATURE AND BUCKLING. E. G. Silver (Oak Ridge National Lab., Tenn.).

During investigations of the decay constant of the fundamental-mode neutrons in finite Be bodies, using the pulsed-neutron-source technique, it was observed that long-term changes in the decay "constant" occurred which were not expected on the basis of the approximate solutions of the transport equations usually applied to this experiment. More extensive experiments in both Be and H_2O (ice) as a function of temperature from +25 to −100°C showed that in Be such changes, which continue over the time span accessible to observation (~10 half lives), are a strong function of temperature and buckling, increasing with buckling, and decreasing with increasing temperature. In ice, on the other hand, it appears that, within the limits of experimental accuracy, an asymptotic value of the decay constant is attained a few thermal-neutron half lives after the neutron burst at all temperatures down to −100°C. These observations are in accord with the "trapping effect" postulated by G. de Saussure. (auth)

15200 (BNL-719(Vol.III)(p.1034-73)) MEASUREMENT OF THE DIFFUSION PARAMETERS OF GRAPHITE AND GRAPHITE–BISMUTH BY PULSED NEUTRON METHODS. E. Starr and G. A. Price (Brookhaven National Lab., Upton, N. Y.). (BNL-6393)

The pulsed-neutron method was used to determine the absorption cross section, the diffusion coefficient, and the diffusion cooling constant of high-purity graphite, bismuth, and graphite-bismuth systems with volume ratios of 4 : 1, 2 : 1, and 1 : 1 by measuring the decay rate of thermal neutrons as a function of moderator geometry. Values of decay data are reported for each of the systems investigated, together with the beometric size. The measurements of the diffusion length by exponential methods have been included in the data reductions which resulted in a more accurate value of the diffusion parameters. (auth)

15201 (BNL-719(Vol.IV) (p.1075-1102)) THE PHASE INTEGRAL METHOD IN NEUTRON THERMALIZATION. Noel Corngold (Brookhaven National Lab., Upton, N. Y.).

Phase integral (WKB) approximations to solutions of the Boltzmann equation are discussed for those models for which the scattering operator may be taken to be a differential operator of second order. Transient, or modal, solutions of the Boltzmann equation in the diffusion approximation are considered. The heavy-gas operator is generalized to include the effects of chemical binding. The information that can be obtained from this model is illustrated with numerical results in the heavy-gas case. (M.P.G.)

15202 (BNL-719(Vol.IV) (p.1103-30)) THE TIME DECAY CONSTANTS IN NEUTRON THERMALIZATION. Noel Corngold, Paul Michael, and Warren Wollman (Brookhaven National Lab., Upton, N. Y.).

The decay constants, γ_k, which appear in the modal expansion of the neutron density in a study of the time-dependent thermalization of neutrons are examined. A study of the proton gas moderator indicates the existence of an infinite number of discrete λ_k in the range $0 \leq \lambda < (2/\sqrt{\pi})\ \Sigma_{tf}\ v_B$. The upper limit is a limit point for the eigenvalue sequence. Consideration of more general models indicates the existence of a discrete spectrum in the range $0 \leq \lambda \leq (v\Sigma_s)_{min}$ and $\lambda \geq (v\Sigma_s)_{max}$ and a continuous spectrum in $(v\Sigma_s)_{min} \leq \lambda \leq (v\Sigma_s)_{max}$. (auth)

15203 (BNL-719(Vol.IV) (p.1158-74)) THE NEUTRON ASYMPTOTIC DECAY CONSTANT IN A SMALL CRYSTALLINE MODERATOR ASSEMBLY. G. de Saussure (Oak Ridge National Lab., Tenn.).

The effect of the narrow peak of the neutron-transport cross section of crystalline materials at low energy is being investigated. It is shown that an upper bound can be found for the asymptotic decay constant in a small assembly. This upper bound is lower than the values usually measured by the pulsed-neutron source technique. This apparent discrepancy is discussed. (auth)

15204 (BNL-719(Vol.IV) (p.1186-1210)) ON THE CALCULATION OF THERMAL NEUTRON DIFFUSION PARAMETERS. Henry C. Honeck (Brookhaven National Lab., Upton, N. Y.).

The theory of pulsed-neutron and diffusion-length experiments is reviewed. It is shown that the two experiments are equivalent, although the diffusion-length experiment is inherently more accurate. A direct numerical method is developed for solving the transport-equation eigenvalue problem. The decay constants and angular spectra are computed for light and heavy water and for graphite. The eigenvalue equation is investigated by means of a power series expansion, and the decay constants obtained are compared with those obtained by the direct numerical method and from experiments. (M.P.G.)

15205 (BNL-719(Vol.IV) (p.1211-31)) MILNE'S PROBLEM FOR THERMAL NEUTRONS. R. Kladnik (Nuklearni Institut "Josef Stefan" Ljubljana, Yugoslavia).

In Milne's problem, the stationary distribution of neutrons in a semi-infinite spectrum-regenerating medium is calculated. Neutrons are supplied to the medium from infinity only, and they are of Maxwellian velocity spectrum at a temperature of the medium. The other half of the space is filled up with vacuum that swallows all neutrons crossing the boundary. There are no neutrons entering the medium at the boundary. The problem is confined to the case of a source-free nonmultiplying medium with anisotropic scattering-law. The linear extrapolation distance and the velocity-angular distribution of neutrons streaming into vacuum are determined. For this purpose, a variational method has been developed. A short review of this method is given, and the numerical methods with results for nonabsorbing monatomic gaseous media are discussed in more detail. (auth)

15206 (BNL-719(IV) (p.1232-54)) ON THE SOLUTION OF THE TIME DEPENDENT NEUTRON THERMALIZATION PROBLEM. Juan U. Koppel (General Atomic Div. General Dynamics Corp., San Diego, Calif.). (GA-2988)

An approximate solution of the time- and energy-dependent Boltzmann equation is obtained for the case of zero absorption. It is shown that the equation can be solved by separation of the variables only if a continuum of singular eigenvectors is introduced in addition to a discrete spectrum of regular eigenfunctions. The completeness of the whole set of eigenvectors is proved for $K = 1$. The results are given in the first-order approximation of the scattering kernel. Only the expansion of the scattering kernel is truncated after a finite number of terms. The solution corresponding to any truncated kernel is exact. Numerical calculations are performed for the free-hydrogen-gas kernel, and another approach to the problem is briefly outlined. (M.P.G.)

15207 (BNL-719(Vol.IV) (p.1255-71)) THERMAL DIFFUSION OF NEUTRONS. I. Kuščer (Ljubljana, Yugoslavia. Univerza. Fizički Institut).

The influence of temperature differences on stationary neutron distributions in extended nonabsorbing media is studied for two cases. In the case of a plane temperature discontinuity in an otherwise uniform medium some information is obtained by aid of an integral of the transport equation. A more general treatment by a simple P_1 approximation is possible if the temperature is a slowly varying function of the coordinates. The general aspects of this case are known from the theory of thermal diffusion, and the results of this theory are easily taken over and adapted to the specific assumptions of neutron transport theory. Expressions are given, by which the thermal diffusion factor, along with the coefficient for ordinary diffusion of thermal neutrons, can be calculated for any given scattering law. (auth)

15208 (BNL-719(IV) (p.1289-98)) SPACE-DEPENDENT NEUTRON THERMALIZATION. J. A. Bewick, R. K. Osborn, and P. F. Zweifel (Michigan. Univ., Ann Arbor).

The thermal neutron spectrum is calculated using the P_1 transport equations and the heavy-gas cross section for scattering by moderator atoms. A consistent expansion of the gas cross section and the diffusion coefficient to first order in μ, the inverse moderator mass, leads to a spectrum which is nearly identical to that calculated by Hurwitz, in which the diffusion coefficient is assumed to be constant and several terms of first order in μ in the energy moments of the gas cross section are ignored. (auth)

15209 (BNL-719(Vol.IV) (p.1299-330)) SPACE AND TIME DEPENDENT EIGENVALUE PROBLEM IN NEUTRON THERMALIZATION. Hiroshi Takahashi (European Atomic Energy Community. Nuclear Research Center, Ispra, Italy).

The matrix elements of the neutron-scattering kernel for a free gas and a crystalline material expanded in terms of Laguerre polynomials of energy, weighted by a Maxwellian distribution, are obtained by a generating function for the Laguerre polynomial. The eigenvalue problems for spatial- and time-dependent neutron thermalization are solved using the obtained matrix element. First-order Laguerre polynomials are used for the spatial problem, and half-order Laguerre polynomials are used for the time-dependent problem, because they diagonalize, respectively, the spatial- and the time-dependent term. The convergence of eigenvalues and eigenfunctions in the time-dependent problem using half-order Laguerre polynomials is rather slow compared with the spatial problem's convergence. The diffusion-cooling coefficients for a Debye crystalline model and graphite are calculated from the eigenvalues and eigenfunctions in the time-dependent problem. The results obtained for beryllium and graphite are, respectively, 3.36 and 2.4 times as large as those obtained by the Nelkin theory. (auth)

15210 (BNL-719(Vol.IV) (p.1331-59)) SPACE–ENERGY SEPARABILITY IN PULSED NEUTRON SYSTEMS. M. M. R. Williams (London. Univ. Queen Mary Coll.).

The time-, energy- and space-dependent Boltzmann equation was studied in order to obtain information on the diffusion-cooling coefficient and other pulsed-neutron parameters. In order to interpret experiments correctly, it is essential to know what is meant by buckling in an energy-dependent system. It is shown by an exact spatial analysis of the energy spectrum that this can be identified with the square of the infinite-medium Fourier-transform variable only if the extrapolation distance, Zo, is itself a function of buckling. The value of $Zo(B^2)$ was calculated, together with the average energy of the spectrum across the system. (auth)

15211 (BNL-719(Vol.IV) (p.1360-74)) TRANSPORT THEORY OF NEUTRONS IN HEAVY GAS IN PLANE GEOMETRY. I. THE INFINITE MEDIUM AND CONSTANT TOTAL CROSS-SECTION. Roman S. Zelazny (Case Inst. of Tech., Cleveland).

A general method for the solution of the neutron transport equation in a heavy gas in plane geometry in the case of an infinite medium and constant total cross section is presented. This solution is based on the eigenfunction expansion method introduced originally in one-velocity transport theory by Case. The complete set of eigenfunctions was derived, and the calculation of the Green function for the Boltzmann equation in an infinite medium was discussed. For a total cross section slowly varying with energy the perturbational procedure was suggested. (auth)

15212 (BNL-719(Vol.IV) (p.1375-90)) ASYMPTOTIC DISTRIBUTION OF THERMAL NEUTRONS FAR FROM A PLANAR SOURCE. L. V. Maiorov.

The distribution of thermal neutrons far from a planar source, in subcritical homogeneous and inhomogeneous media, is analyzed with account of thermalization and fission. (auth)

15213 (GA-3409) DIFFERENTIAL NEUTRON THERMALIZATION. Annual Summary Report, October 1, 1961 through September 30, 1962. W. L. Whittemore (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Nov. 28, 1962. Contract AT(04-3)-167. 65p.

Experimental and theoretical work on the interaction mechanisms by which neutrons exchange energy with H atoms involves treating neutron thermalization as neutron interactions with energy levels in the atoms. Cold moderators are presently being studied in order to optimize the source of cold neutrons. Cold neutrons are provided from an accelerator arrangement that directs electrons against a Fansteel target producing fast neutrons. Thermal neutrons, produced by moderation of fast neutrons, are passed through a chopper. Several moderators are evaluated, and neutron emission time measurements by crystal diffraction and beam chopper techniques point out emission time dependence on thickness, moderator, and temperature. The neutron beam chopper used presently is described, and results of neutron scattering by liquid para- and ortho-hydrogen are displayed and compared with theoretical predictions made with a perfect hydrogen gas model. Inelastic scattering of neutrons by liquid H is discussed, and theoretical and experimental results of inelastic scattering by polyethylene are also included. (D.C.W.)

15214 (GEAP-4017) ABSORBER BURN-UP EXPERIMENT. Final Report. J. L. Russell, Jr., M. R. Carrothers, and W. V. Mosgovoy (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). Apr. 1962. Contract AT(04-3)-189. 116p.

Experimental results are presented of pile oscillator measurements of cross sections of irradiated samples of seventeen elements. Mass spectrometer analysis of some samples was performed. Quantitative theory-experiment correlation yielded thermal absorption cross section information and also established the reliability of control rod lifetime calculations for each element investigated. Application of the results to calculation of the nuclear lifetime of reactor control rods is discussed. (auth)

15215 (NAA-SR-Memo-7776) SIG-CUM—A CODE TO TREAT ANISOTROPIC ELASTIC SCATTERING OF NEUTRONS. F. D. Rudnick and H. J. Lorenzi (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Oct. 22, 1962. Contract [AT(11-1)-Gen-8]. 44p.

Program SIG-CUM generates a set of coefficients, C_l, which describe the normalized angular distribution, $d\xi/d\eta$ as a power series in η, the cosine of the scattering angle. The result is applied to treating anisotropic scattering in Monte Carlo shielding problems. The C_l are actually linear combinations of the elastic scattering coefficients which are obtained from a Legendre polynomial expansion of the differential scattering cross section. Calculations are carried out in the laboratory system, and a transformation routine is provided for data entered in the center of mass. (auth)

15216 (NP-12502) SLOW-NEUTRON SCATTERING BY MOLECULES OF LIQUID METHANE. Z. Rogalska (Polish Academy of Sciences. Inst. of Nuclear Physics, Krakow). Oct. 1962. 16p.

The total slow neutron scattering cross section of liquid methane molecules as a function of neutron energy was measured. Agreement between experimental results and the theoretical curve, calculated on the basis of the Krieger and Nelkin theory for gaseous methane, was found. The most reasonable interpretation of this agreement was attributed to the fact that there exists a free rotation of molecules in liquid methane. It might be concluded that a free rotation is maintained at the transition from gas to liquid. (auth)

15217 (ORNL-TM-461) NEUTRON THERMALIZATION PROGRAMS FOR THE IBM 7090. C. A. Preskitt, E. A. Nephew, and M. E. Tsagaris (Oak Ridge National Lab., Tenn.). Feb. 25, 1963. Contract W-7405-eng-26. 97p.

A system of six codes is described that permits the solution of a broad class of problems encountered in the study of neutron thermalization, average cross sections, and spectral models. These programs are all compatible with use on MONITOR for the IBM 7090. The Fortran listings are given. (auth)

15218 (PAN-353/I-A) THE ADAPTATION OF THE 14 Mev NEUTRON GENERATOR TO THE MEASUREMENTS OF NEUTRON SPECTRA BY TIME OF FLIGHT TECHNIQUE. Jerzy Januszewski, Józef Koralewski, Włodzimierz Kusch, Zbigniew Moroz, and Jolanta Wojtkowska (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Aug. 1962. 13p.

A system consisting of deflecting plates with h-f generator, electromagnet bending of the beam, quadrupole lens, control chambers, and target chamber was built. The system provides a pulsed deuteron beam from the 200 kev accelerator to produce a pulsed neutron flux for fast neutron spectroscopy. (auth)

15219 (PAN-355/I-B) STUDIES OF CORRELATION FUNCTIONS IN LIQUIDS BY NEUTRON SPECTROMETRY. Kazimierz Mikke (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Aug. 1962. 18p.

The formalism introduced originally by Van Hove allows expression of the differential scattering cross section of slow neutrons in terms of the space-time correlation function of the scatterer. Following this approach, new information on the liquid state of matter can be obtained. The results on diffusive motions in liquids are particularly interesting. New experimental methods and the results of recent work on correlation functions in liquid media are reviewed, and the future trends in this field are discussed. (auth)

15220 (TID-18007) DIFFUSION PARAMETERS OF WATER. Robert L. Hobson, Gerald P. Calame, and P. B. Daitch (Rensselaer Polytechnic Inst., Troy, N. Y.). [Feb. 20, 1963]. Contract [AT(30-3)-328]. 4p.

Comparison of experiment and theory in the determination of diffusion cooling coefficients is investigated. The asymptotic eigenvalue for the pulsed neutron problem was computed for 11 bucklings and least square fitted to a curve. The form of the curve to provide the best fit with experimental data is discussed. (D.C.W.)

15221 (TID-18008) THE DISCRETE ENERGY REPRESENTATION OF THE THERMALIZATION PROBLEM. P. B. Daitch and M. J. Ohanian (Rensselaer Polytechnic Inst., Troy, N. Y.). [Feb. 20, 1963]. Contract [AT(30-3)-328]. 8p.

The validity of a discrete representation of the energy variable in view of the existence of a continuum of eigenvalues has been examined. For an infinite medium with 1/v absorption and a spatially constant source, time de-

pendent and steady state spectra were generated both directly from the Boltzmann equation and from an eigenfunction expansion, using the Mass-1 and the Nelkin kernel. The steady state solution of the Boltzmann equation with the Mass-1 kernel yielded the Wigner-Wilkins spectra, and eigenfunctions found for the time dependent equation form an orthonormal set that represents all functions over the discrete set of energies considered. (D.C.W.)

15222 ABSOLUTE MEASUREMENT OF THE INTENSITY OF A Ra–α–Be NEUTRON SOURCE. N. Mateescu and V. Nahorniak. Acad. Rep. Populare Romine, Studii Cercetari Fiz., 13: 367-73(1962). (In Rumanian)

Ra–Be sources are often used as reference standards for neutron fluxes. For practical reasons, it is preferred to slow down the fast neutrons to thermal energies, then determine the thermal flux in various points of the moderator. The method of spatial integration of the thermal flux was used, measuring the neutron distribution in distilled water which has a great slowing-down power. Gold and indium foils were used as detectors; the absolute activity was measured by means of β–γ coincidences. The value of $\eta = A_T^{Au}/A_T^{In}$ was found to be 0.0863 ± 2.0%. (TTT)

15223 DETERMINATION OF THE SLOWING-DOWN DENSITY OF NEUTRONS IN A GRAPHITE PRISM, MAKING USE OF A Ra–α–Be SOURCE. N. Mateescu and V. Nahorniak. Acad. Rep. Populare Romine, Studii Cercetari Fiz., 13: 375-85(1962). (In Rumanian)

A Ra–Be neutron source with a graphite moderator was used for the preparation of a reference standard for thermal neutron fluxes. The work involved the measurement of the spatial distribution of the slowing-down density on the basis of the activation of In foils along the principal axis of the graphite prism for determining the spatial distribution of the thermal neutrons. The prism was provided with a 0.5-mm thick Cd layer to prevent the back-scattering of the neutrons. The activity of the exposed In foils was measured by means of G-M counters, the efficiency of which was checked by a Co^{60} point source. The calculated value of the thermal neutron flux was found to be 5100 n/cm^2 which was lower than the value obtained by absolute measurement. (TTT)

15224 DEPENDENCE OF THE YIELD OF THE NEUTRON DOSE, AS A FUNCTION OF THE YIELD OF THE γ RADIATION DOSE, IN THE CASE OF Po–Be SOURCES USED IN INDUSTRY. I. Apostol and M. Oncescu [(Inst. of Atomic Physics, Bucharest)]. Acad. Rep. Populare Romine, Studii Cercetari Fiz., 13: 427-35(1962). (In Rumanian)

The yield of the γ dose resulting from work with Po–Be neutron sources can be easily measured by using output meters fed by a battery. In the present study, a calculation method is proposed which permits the utilization of a relation existing between the neutron dose yield and the γ-radiation dose yield measured behind a screen. The radiation attenuation is obtained by using the attenuation cross section method. By making the necessary calculations, the relation $b_{n,r} = (1 - p_{\gamma,r})\ (b_{\gamma,r}/p_{\gamma,r})$ is found, where $b_{n,r}$ and $b_{\gamma,r}$ designate the neutron dose yield and the γ quanta and $p_{\gamma,r}$ the fraction, of the total dose yield, belonging to the γ quanta at the distance r from the source. The theoretical data were experimentally confirmed. The results are presented in diagrams. (tr-auth)

15225 A METHOD FOR DETERMINING THE EFFECTIVENESS OF A GROUP OF SYMMETRICALLY DISTRIBUTED ABSORBER RODS ON THE BASIS OF THE TWO-GROUP DIFFUSION THEORY. R. Martinc. Bull. Inst. Nucl. Sci. "Boris Kidrich" (Belgrade), 13: No. 3, 21-9 (Oct. 1962). (In English)

An equation for determining the effectiveness of a group of black absorber rods symmetrically arranged in a ring is derived. The applicability of the derived equation, depending on the reactivity worth of the absorber system and the properties of the reactor system in which the absorber rods are inserted, is discussed. The application of this equation considerably shortens the calculation for determining the reactivity worth of symmetrically arranged absorber rods on the basis of the two-group diffusion theory. (auth)

15226 THE EFFECT OF THE CHEMICAL BONDING ON THE NEUTRON SLOWING DOWN PROCESS IN HEAVY WATER. Wolfgang Eichelberger (Technische Hochschule, Karlsruhe, Ger.). Nukleonik, 4: 326-31(Dec. 1962). (In German)

The energetic neutrons produced at the Karlsruhe 31-Mev betatron by the (γ,n) process in lead were moderated in heavy water. At an energy of 1.44 ev, they could be detected by (n,γ) resonance capture in indium by using a γ-sensitive detector. Since the last collisions determine decisively the total slowing down time, the temporal distribution of the neutrons detected is modified significantly by the chemical bonding of the moderator molecule. As the measurement shows, the deuterons in the molecular bond behave as particles with an effective mass of 3.0 ± 0.5 proton mass. (tr-auth)

15227 AN INTRODUCTION TO TRANSPORT THEORY. G. Milton Wing. New York, John Wiley and Sons, Inc., 1962. 182p.

Classical and invariant imbedding approaches are used with various transport models to derive equations for transport processes. An analysis of two transport models is presented, and time-dependent transport is introduced. A problem of time-dependent transport in a slab geometry is solved, and a generalized invariant imbedding approach is presented as well as some nonlinear transport models. (D.C.W.)

15228 INELASTIC SCATTERING OF NEUTRONS IN SOLIDS AND LIQUIDS. VOL. I. Proceedings of the Symposium held at Chalk River, Canada, September 10-14, 1962. (International Atomic Energy Agency, Vienna). Proceedings Series. Jan. 1963. 474p. (STI/PUB/62(Vol. I.)). $9.00; 189s; NF 36; DM 31.50(IAEA).

Sixty-seven papers on the use of neutron scattering to study the internal dynamics of liquids, molecules, and solids are presented in two volumes. Separate abstracts have been prepared for eighteen of the thirty-eight papers in Volume I; twenty papers have been previously abstracted in NSA. (D.C.W.)

15229 THE MÖSSBAUER EFFECT AND DYNAMICS OF ATOMIC MOTIONS IN CONDENSED SYSTEMS. K. S. Singwi (Argonne National Lab., Ill.). p.3-14 of "Inelastic Scattering of Neutrons in Solids and Liquids. Vol. I." Vienna, International Atomic Energy Agency, 1963. (In English)

The Mössbauer effect is briefly discussed, and use of the effect to study various phenomena in liquids and solids is examined. Diffusion, second order Doppler shift, the influence of impurity atoms on lattice dynamics, dispersion relations for phonons, and observance of zero sound in liquid He^3 are areas treated. Similarities between the phenomena of slow neutrons scattering and γ-ray resonance scattering are noted. (D.C.W.)

15230 PERTURBATION THEORY OF ANHARMONICITY EFFECTS IN SLOW NEUTRON INELASTIC SCATTER-

ING BY CRYSTALS. H. Hahn (Institut für Reaktorwerkstoffe Kernforschungsanlage, Jülich, Ger.). p.37-48 of "Inelastic Scattering of Neutrons in Solids and Liquids. Vol. I." Vienna, International Atomic Energy Agency, 1963. (In English)

An earlier perturbation treatment of the corresponding x-ray scattering problem is generalized into a calculation of the effect of vibrational anharmonicity on the scattering of slow neutrons by crystals. Of an expansion of the lattice potential in powers of the deviations from the thermally averaged sites, the cubic terms are taken into account up to second order; only first order terms are kept in the quartic anharmonicities. All higher terms are neglected. In particular, formulae for the shifts and broadenings of the one-phonon peaks in coherent scattering are derived in terms of the third and fourth order coupling coefficients. As in x-ray scattering, a simple quadratic relation exists between the shifted "effective frequencies" of the long wavelength lattice vibrations and the isothermal elastic constants of the crystal. The lattice frequencies of the harmonic approximation may be obtained by extrapolating to absolute zero the linear dependence on temperature shown by the shifted frequencies above the Debye temperature. (auth)

15231 THE CALCULATION OF DEBYE-WALLER FACTORS FROM THERMODYNAMIC DATA. T. H. K. Barron (Bristol Univ., Eng.), A. J. Leadbetter, J. A. Morrison, and L. S. Salter. p.49-58 of "Inelastic Scattering of Neutrons in Solids and Liquids. Vol. I." Vienna, International Atomic Energy Agency, 1963. (In English)

Properties of crystals that depend primarily upon the lattice frequency spectrum can be related exactly within the quasi-harmonic approximation. Such properties include thermodynamic quantities, and the temperature dependence of the intensities of Bragg reflections; the latter is usually expressed as the Debye-Waller factor. From analyses of appropriate heat capacity and thermal expansion data for simple crystals, it is possible to calculate Debye-Waller factors and their dependence upon temperature and volume much more accurately than they may be obtained by direct measurement. The importance of this is its possible use in the analysis of complicated scattering processes. An equivalent Debye characteristic temperature, Θ^M, can be defined for cubic crystals. Its variation with temperature is small: for $T > \Theta^M/3$, Θ^M tends to a constant value which is usually less than characteristic temperatures calculated from heat capacity data at either low or high temperatures. Anharmonic effects appear to be small in the region $T < 2\Theta^M$. The general method of analysis is illustrated with specific examples. (auth)

15232 DIELECTRIC CONSTANTS AND LATTICE VIBRATIONS IN IONIC CRYSTALS. W. Cochran and R. A. Cowley (Cavendish Lab., Cambridge, Eng.). p.59-63 of "Inelastic Scattering of Neutrons in Solids and Liquids. Vol. I." Vienna, International Atomic Energy Agency, 1963. (In English)

A number of relations have been derived between the static and high-frequency dielectric constants of crystals and the frequencies and polarization properties of optic phonons of small wave-number. The concept of "apparent charge" is important in this connection. It is a quantity that can be measured experimentally but is not the same as ionic charge. It should be possible to determine apparent charges by a combination of the results of measurement of reflectivity in the infrared, and of neutron inelastic scattering. (auth)

15233 A NEW APPARATUS FOR INELASTIC, QUASI-ELASTIC AND ELASTIC COLD NEUTRON MEASUREMENTS. K. Otnes and H. Palevsky (Brookhaven National Lab., Upton, N. Y.). p.95-106 of "Inelastic Scattering of Neutrons in Solids and Liquids. Vol. I." Vienna, International Atomic Energy Agency, 1963. (In English)

A new chopper apparatus for use at the Brookhaven High Flux Beam Reactor is now under construction. It is a three-element phased rotor system. The rotors are 80 cm in diameter, run at a maximum speed of 15000 rev/min, and are designed to give three neutron bursts of monochromatic neutrons per revolution. Two rotors spin about a horizontal axis whereas the third operates vertically. The system can be operated with either one, two, or three of the chopper elements, depending on the type of measurements that is completed. For inelastic measurements where the neutron gains energy, a double rotor system will be most useful. For this configuration the burst time and wave length spread (full widths at $\frac{1}{2}$ maximum) will be 16 μs and 0.16 Å for 4 Å incident neutrons, and the intensity at the sample (4 × 1.6 cm) will be 2×10^6 n/s. For quasi-elastic and elastic neutron measurements the three-rotor configuration will be best suited. The corresponding burst time and wave length spread can be as small as 8 μs and 0.04 Å giving an intensity of 10^4 n/s on a sample of (4 × 0.8 cm). The wave length and time resolution are adjustable between the above two limits in such a way as to obtain the maximum neutron intensity for a given experiment. (auth)

15234 INSTALLATION FOR STUDYING THE SCATTERING OF COLD NEUTRONS. V. V. Golikov, F. L. Shapiro, A. Shkatula, and E. A. Yanik (Joint Inst. for Nuclear Research, Dubna, USSR). p.119-125 of "Inelastic Scattering of Neutrons in Solids and Liquids. Vol. I." Vienna, International Atomic Energy Agency, 1963. (In Russian)

Using the pulsed fast reactor in the Joint Institute for Nuclear Research, an installation was set up to investigate the spectrometry of cold neutrons. The moderator, adjoining the reactor reflector, and the beryllium filter were at the temperature of liquid nitrogen. The scatterer, located at a distance of about 0.6 m from the moderator, was irradiated by flashes of cold neutrons, whose duration was determined by the lifetime of the neutrons in the moderator and the dispersion of the times-of-flight over a distance of 0.6 m. The frequency of the flashes was 8/sec. The steep beryllium edge of the spectrum, lying around 200 μs, was used for spectrometry in the quasi-elastic range. The energy of the scattered neutrons was determined by the time-of-flight over the distance between scatterer and detector that was about 10–40 m. ZnS + $B_2^{10}O_3$ scintillation detectors with surfaces of 300 and 2000 cm^2 were used and the efficiency, for fast neutrons, was about 60%. (auth)

15235 A DOUBLE SLOW NEUTRON SPECTROMETER. I. I. Bondarenko, V. G. Liforov, M. N. Nikolaev, V. V. Orlov, V. A. Parfenov, V. A. Semenov, B. I. Smirnov, and V. F. Turchin. p.127-37 of "Inelastic Scattering of Neutrons in Solids and Liquids. Vol. I." Vienna, International Atomic Energy Agency, 1963. (In Russian)

The neutron spectrometer described is intended for measurements of the angular and energy distribution of monochromatic slow neutrons, inelastically scattered by liquid and solid bodies. Experiments of this type permit detailed information to be obtained concerning the dynamics of the atoms in various aggregate states of a substance. The spectrometer is based on the time-of-flight method. The pulse source of neutrons is the IBR (1) reactor. A mechanical interrupter, rotating synchronously with the disc of the IBR and having a prescribed phase shift, serves as the monochromator. A special phasing system ensures a phase stability better than 0.5°. The neutrons scattered by the sample are recorded by a scintillation detector set at

a given angle to the neutron beam. The resolving power of the spectrometer is ~15 μs/m. A detailed description of the construction of the spectroscope and its characteristics is given. (auth)

15236 THE TRANSMISSION OF THERMAL NEUTRONS THROUGH A LARGE SINGLE CRYSTAL OF BISMUTH AT LIQUID NITROGEN TEMPERATURE. S. Menardi, R. Haas, and W. Kley (Euratom, C.C.R., Ispra, Italy). p.139-46 of "Inelastic Scattering of Neutrons in Solids and Liquids. Vol. I." Vienna, International Atomic Energy Agency, 1963. (In English)

The transmission of a bismuth filter, at the temperature of liquid nitrogen, was measured using a slow chopper and a flight path of 5.4 m. The filter is made of two "single crystals," each 20 cm long and 5 cm in diameter. According to specification of the manufacturer each "single crystal" consists of maximum three of four columns of single crystals. In the energy range from 25–10 Mev, the transmitted intensity is about 30% of the expected value. In the range from 5 Mev to lower energies, the transmission is of the order of 60–70%. A cadmium ratio of 5000 was measured. The actual cadmium ratio may still be higher since the measurement was not made with a really fast neutron collimator. In spite of many coherent dips in the transmission curve, the performance of the filter is rather satisfactory for the production of a thermal neutron beam that is predominantly free from fast neutrons and γ-rays. Possible applications of a filtered neutron beam are discussed. (auth)

15237 PROBLEMS ASSOCIATED WITH THE MONOCHROMATIZATION OF SLOW NEUTRONS. V. P. Vertebnyi, V. V. Kolotyi, and A. N. Maistrenko. p.147-69 of "Inelastic Scattering of Neutrons in Solids and Liquids. Vol. I." Vienna, International Atomic Energy Agency, 1963. (In Russian)

The result of calculations to determine the shape of the spectral line of twin-rotor, pulsing, slow-neutron monochromators, as a function of the shifts in the phases between the rotors is presented. Consideration is also given to the possibility of using certain light elements as slow-neutron filters. (auth)

15238 INTERPRETATION OF COHERENT NEUTRON SCATTERING BY LIQUIDS. P. A. Egelstaff (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.203-14 of "Inelastic Scattering of Neutrons in Solids and Liquids. Vol. I." Vienna, International Atomic Energy Agency, 1963. (In English)

The thermal motion in liquids differs from that in solids (collective modes only) and gases (single particle modes only) by having both collective and single particle modes of equal importance. Coherent neutron scattering offers a powerful tool for studying the properties of these modes, in particular the interactions between them, and such effects are shown to be important at low momentum and energy transfers. It is shown also how the damping of longitudinal sound waves is large for the frequencies excited by the neutron interaction and should be observable experimentally. Qualitative comparisons are made between the theoretical predictions and the experimental data on liquid lead and tin, that indicate profitable directions for future work. (auth)

15239 COMPARATIVE STUDIES OF SLOW NEUTRON SCATTERING BY SOLID AND LIQUID TIN. S. J. Cocking and Z. Guner (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.237-48 of "Inelastic Scattering of Neutrons in Solids and Liquids. Vol. I." Vienna, International Atomic Energy Agency, 1963. (In English)

The scattering of 4.0 and 6.2 Å neutrons by tin as solid (210°C) and liquid (240°C) was measured. The scattered spectra at six scatter angles between 20 and 90° was analyzed by time-of-flight methods. At the longer wavelength the low intensity elastic scattered peaks were used to derive the incoherent cross section for tin (0.04 ± 0.01 b). Sharp steps in scattered spectra for the solid can be identified and similar but broadened steps for the liquid are seen. Using a theory due to Egelstaff, the steps for the solid can be interpreted as the excitation of particular phonons. The single phonon theory for the solid is modified to attempt to account for the different behavior of the liquid. The appreciable scattering observed in the liquid at low energy transfers is not explained in this way. (auth)

15240 SCATTERING OF NEUTRONS BY LIQUID BROMINE. G. E. Cotte and B. C. Haywood (Atomic Energy of Canada Ltd., Chalk River, Ont.). p.249-58 of "Inelastic Scattering of Neutrons in Solids and Liquids. Vol. I." Vienna, International Atomic Energy Agency, 1963. (In English)

Neutrons of 0.037 and 0.0088 ev were scattered from a thin sample of liquid bromine at room temperature, and the energy distributions of the scattered neutrons measured at angles from 10 to 160° by the time-of-flight method. The angular distribution confirms the results of a previous study by Caglioti. Spectra were expressed in the form of the "scattering law" $S(\alpha\beta)$ of Egelstaff and analyzed to derive the generalized frequency distribution $p(\beta)$ of atomic motions in the liquid. The function $p(\beta)$ has a broad smooth peak centered at $\beta \approx 0.3$, and shows no evidence for discrete levels in the measured range $0 < \beta < 0.8$; the general shape of the curve supports the "quasi-crystalline" picture of the liquid. Difficulty in the absolute normalization of $p(\beta)$ is discussed. (auth)

15241 NEUTRON SPECTROMETRY WORK AT THE CNEN. G. Caglioti and P. Ascarelli (Comitato Nazionale per l'Energia Nucleare, Ispra, Italy). p.259-62 of "Inelastic Scattering of Neutrons in Solids and Liquids. Vol. I." Vienna, International Atomic Energy Agency, 1963. (In English)

A conventional triple axis spectrometer recently installed at the CNEN is described, and results of preliminary measurements of the angular distribution of quasi-elastic scattering of 1.4A neutrons by liquid bromine are displayed. The results indicate that even for a heavy liquid element, the neutron scattering process is inelastic. An attempt to fit the experimental data with a convolution approximation and a model for the liquid was also made. (D.C.W.)

15242 DYNAMICS OF LIQUID HYDROGEN BY NEUTRON SCATTERING. A. W. McReynolds (International Atomic Energy Agency, Vienna) and W. L. Whittemore. p.263-71 of "Inelastic Scattering of Neutrons in Solids and Liquids. Vol. I." Vienna, International Atomic Energy Agency, 1963. (In English)

The total scattering cross section of liquid para-hydrogen for neutrons below about 0.014 ev is found to conform approximately to the Schwinger-Teller theory for para-hydrogen gas, indicating very weak intermolecular forces. A minimum of about 3 b per hydrogen atom is reached at about 0.014 ev as a result of coherence of scattering from oppositely oriented atoms in the molecule. A sharp rise with increasing neutron energy above this threshold corresponds to inelastic collisions in which the neutron spin is reversed and the molecule is thus converted from para- to ortho-hydrogen, absorbing the energy difference between the $J = 0$ and $J = 1$ ground rotational levels of the para and ortho states. Preliminary measurements of the neutron

energy loss in both energy regions confirm these interpretations and are being continued for more detailed investigation of liquid dynamics. (auth)

15243 SLOW NEUTRON SCATTERING BY BENZENE. V. C. Boffi (Comitato Nazionale per l'Energia Nucleare, Rome), V. G. Molinari, and D. E. Parks. p.285-95 of "Inelastic Scattering of Neutrons in Solids and Liquids. Vol. I." Vienna, International Atomic Energy Agency, 1963. (In English)

The scattering of slow neutrons by the benzene molecule, is calculated within the framework of the time-dependent formalism of Zemach and Glauber. Detailed account is taken of the effects of the molecular vibrations on the neutron scattering. Among the results explicitly calculated are the slow neutron total scattering cross section as a function of energy and the energy angular distribution of singly scattered sections. Experimental and theoretical results for the total cross section of hydrogen atoms in benzene are also discussed. (auth)

15244 INELASTIC SCATTERING OF THERMAL NEUTRONS FROM DOWTHERM "A." W. Glaeser (Kernforschungszentrum Karlsruhe, Ger.). p.307-15 of "Inelastic Scattering of Neutrons in Solids and Liquids. Vol. I." Vienna, International Atomic Energy Agency, 1963. (In English)

The angular and energy distributions of neutrons scattered from room temperature samples of Dowtherm "A" were measured using a few different initial neutron energies in the range from 10^{-2} to 10^{-1} ev. The experiment was performed with a rotating crystal spectrometer as pulsed monoenergetic beam source and a 16 × 256-channel time analyzer for timing of the scattered neutrons. With this arrangement data for several angles were taken simultaneously. Results are represented in the form of differential cross-sections and also in the "Scattering Law" form. Physical interpretations with the aid of the space-time correlation function of Van Hove is discussed. (auth)

15245 A STUDY OF THE DIFFUSIVE ATOMIC MOTIONS IN GLYCEROL AND OF THE VIBRATORY MOTIONS IN GLYCEROL AND LIGHT AND HEAVY WATER BY COLD NEUTRON SCATTERING. K. E. Larsson and U. Dahlborg (Aktiebolaget Atomenergi, Stockholm). p.317-42 of "Inelastic Scattering of Neutrons in Solids and Liquids. Vol. I." Vienna, International Atomic Energy Agency, 1963. (In English)

The cold neutron scattering studies of the vibrational and diffusive properties of light and heavy water have been continued at the Stockholm reactor. Vibrational "frequency spectra" have been derived from observations on heavy water up to 350°C. The damping of the molecular vibrations and rotations is very strong at the higher temperatures. A study has been performed on the quasi-elastic and inelastic scattering from glycerine, a hydrogenous liquid showing a strong variation of its viscosity with temperature. The diffusion constants that may be deduced from the experiment are several powers of ten larger than those calculated from the Einstein-Stoke or from the Eyring formulas using the measured viscosity. The variation of line width with temperature shows a tendency opposite of that for water, which indicates that for glycerine jump diffusion might be the most important process. The broad inelastically scattered spectrum from glycerine shows similarities to the spectra derived from the measurements on light and heavy water. 21 references. (auth)

15246 QUASI-ELASTIC SCATTERING OF COLD NEUTRONS IN WATER. A. Baiorik, V. V. Golikov, I. Zhukovskaya, F. L. Shapiro, A. Shkatula, and E. A. Yanik (Joint Inst. of Nuclear Research, Dubna, USSR). p.383-8 of "Inelastic Scattering of Neutrons in Solids and Liquids, Vol. I." Vienna, International Atomic Energy Agency, 1963. (In Russian)

The results of investigations carried out with a cold-neutron spectrometer into the quasi-elastic scattering of cold neutrons in water are discussed. The neutron source was a pulsed fast reactor. Measurements were made with resolutions of up to 0.5% and an energy of 5 Mev. (auth)

Nuclear Properties and Reactions

15247 (AERE-R-4101) THE SCATTERING OF COLD NEUTRONS BY METALS. P. A. Egelstaff (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Sept. 1962. 37p.

The differential cross section for the inelastic scattering of cold neutrons by polycrystalline metals is calculated and shown to be proportional to the square of the momentum transfer. This leads to marked anisotropy in the scattering, the magnitude of which depends upon the Debye temperature of the scatterer. This property and also the dependence of the energy spectrum of the scattered neutrons upon the Debye temperature are verified by experiment. Discrepancies between the theory and experiment in the case of beryllium cannot be accounted for by simple modifications to the Debye frequency spectrum and require a more complete theory. The scattering of 14°K neutrons by solid and liquid lead are compared, and are found to be very similar. The mechanism of momentum transfer from neutron to liquid is shown to differ from that to the solid. (auth)

15248 (AERE-R-4227) CODA—A LEAST SQUARES FITTING PROGRAM FOR RADIOACTIVE DECAY CURVES. I. F. Croall (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Jan. 1963. 14p.

A program, for use on an IBM 7090 computer, was written for the analysis of multicomponent radioactive decay curves. Both simple decay and systems involving both growth and decay may be processed. The initial counting rates of each component at zero time and their respective standard deviations are printed out together with information that permits an assessment of the accuracy of the fit to be made. (auth)

15249 (BNL-6765) NEUTRON SOURCES—CROSS SECTIONS AND ANGULAR DISTRIBUTIONS. Murrey D. Goldberg (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract [AT(30-2)-Gen-16]. 33p.

Production of monoenergetic neutrons by the interactions of alpha particles, deuterons, protons, and tritons with light and medium weight nuclei is surveyed. A few medium weight interactions are briefly discussed as is the (p,n) reaction in Li^7. Attention centers on neutron sources involving interactions with hydrogen isotopes. Neutron energies available, production cross sections at 0°, laboratory angular distributions, and the resultant least-squares Legendre coefficient curves are presented for the hydrogen reactions examined. 25 references. (D.C.W.)

15250 (CEA-2199) MESURE ABSOLUE DE CORPS RADIOACTIFS SE DESINTEGRANT PAR CAPTURE ELECTRONIQUE. (Absolute Measurements of Radioactive Bodies Which Disintegrate After Electron Capture). Le Du and Movchet (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1962. 9p.

The calibration methods described include the 4πx (or e)

system for use when K capture is followed by a γ disintegration, and a system in which all of the x rays stopped by the detector are counted and x ray emitters of low energy disintegrating after electron capture yield the values for fundamental levels directly. (J.R.D.)

15251 (CU(PNPL)-220) PROGRESS REPORT FOR JULY, AUGUST, SEPTEMBER, 1962 TO THE UNITED STATES ATOMIC ENERGY COMMISSION. (Columbia Univ., New York. Pegram Nuclear Physics Labs.). Contract AT(30-1)-Gen-72. 55p.

Research and development progress is reported on neutron physics, charged-particle investigations, light-particle investigations, and instrument development. (M.C.G.)

15252 (EANDC(US)-28(L)) STATUS REPORT ON CROSS SECTION MEASUREMENTS IN NORTH AMERICA ON THE FISSIONABLE NUCLEI. H. Goldstein and W. W. Havens, Jr. (Columbia Univ., New York). Sept. 1, 1962. 7p.

The status of neutron cross section measurements in North America on the nuclei from Th^{232} to Pu^{242} inclusive is summarized. (D.C.W.)

15253 (GA-3874) RADIATIVE CAPTURE CROSS-SECTION MEASUREMENTS. Summary Report, March 1, 1962–February 28, 1963. E. Haddad, S. Friesenhahn, and W. M. Lopez (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Contract AT(04-3)-167. Mar. 1, 1963. 67p.

The electron linear accelerator facility used in radiative capture cross section measurements is described. Various segments of the experimental apparatus are also discussed, particularly the 4000-liter liquid scintillator detector completed during the period. Design and operation of the detector and the electronics instrumentation associated with the assembly are explained. The gamma resolution of the detector was obtained from pulse-height distributions (shown) for Cs^{137}, Co^{60}, Pr^{142}, and Na^{24}. A calibration curve giving the dependence of pulse height on gamma energy was also obtained. Notable suppression of in-scattered neutrons by B^{10} epoxy on the Al liner was noted from Au^{197} distributions. Loading of the center cylinder with 10% methyl borate also improved the resolution for Au^{197}. A value of $95 \pm 5\%$ for the zero bias efficiency was reported, and an overall uncertainty of 6% is taken in the detector efficiency when methyl borate is used. The method used in correcting for background and neutron flux effects on thin target cross section measurements are discussed, and preliminary thin target cross section data for Ag, In, Au, and Er are shown. An unexplained discrepancy between cross sections obtained at 0.025 ev and previous measurements appears, the new values being higher. At 30 kv a result of 525 mb was obtained, in excellent agreement with determinations by other techniques. Isotopic assignments were made to several resonances in Er due to Er^{167} by using enriched samples. A number of new resonances were found and their neutron widths were determined. The assignments and widths are listed. Identifications were also made for Ag^{107} and Ag^{109} using unenriched samples. The results confirmed previous data. In addition, a faster technique that will work for any number of isotopes if their binding energies differ by 300 kev or more was developed and used on Ag, giving complete agreement with previous work between 41 and 134 ev. Resonances at 138 and 171 ev had no previous assignments. (D.C.W.)

15254 (HW-SA-2901) TESTS FOR SYSTEMATIC ERRORS IN FAST NEUTRON TOTAL CROSS SECTION MEASUREMENTS. D. G. Foster and D. W. Glasgow (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 12, 1963. Contract AT(45-1)-1350. 13p.

Observed systematic errors in previous measurements have led to a search for such errors in measurements of total cross sections for 3 to 15 Mev neutrons. Transmission measurements with the continuous spectrum of neutrons from a pulsed $Li^7(d,n)Be^8$ source are made using time-of-flight evaluation of neutron energies. Steep slopes of the peaks of the spectrum from the source require unavailable but correctable equipment stability. A (d,p) reaction producing Li^8 that decays by beta emission producing bremsstrahlung requires corrections. In-scattering from the sample and background effects are minimized by use of good geometry. Real systematic departures appear in measurements of the lead cross sections with samples of different thicknesses. Copper and lead measurements are displayed and compared with previous measurements. (D.C.W.)

15255 (IS-475) DISCUSSION OF QUADRUPOLE PRECESSION. J. C. Raich and R. H. Good, Jr. (Ames Lab., Ames, Iowa). [May 31, 1962]. Contract [W-7405-eng-82]. 24p.

The motion of a nucleus with an intrinsic quadrupole moment in an external electrostatic field gradient is discussed from a classical point of view. It is shown that in the classical approximation the angular momentum may precess about the direction of strongest field gradient or about the direction of intermediate field gradient, but not about the direction of weakest field gradient. The classical precession frequencies are found to be related to the quantum mechanical dipole transition frequencies. (auth)

15256 (LA-2811) BETA DECAYS AND DELAYED GAMMAS FROM FISSION FRAGMENTS. James Griffin (Los Alamos Scientific Lab., N. Mex.). Dec. 1962. Contract W-7405-eng-36. 48p.

A theoretical study is made of the gross behavior of beta decays following nuclear fission in times from 10^{-2} to 10 seconds. A model is formulated to describe the situation in terms of a few parameters, after which the most uncertain of these parameters are chosen to fit the observed rate of delayed gamma emission (assumed proportional to the beta-decay rate) for the $U^{235}(n,f)$ process. The description is extended to other isotopes by assuming that they differ only by small shifts of their initial fragment distributions away from that appropriate to neutron-induced fission of U^{235}. The result is a theoretical summary of the presently available data which can be used in predictive extrapolation of that data to situations not yet studied experimentally. (auth)

15257 (PUC-1963-96) THE NUCLEAR MOMENTS OF N^{13} AND C^{11} (thesis). Robert A. Haberstroh (Princeton Univ., N. J. Palmer Physical Lab.). Feb. 1963. Contract AT(30-1)-937. 283p.

The nuclear moments of $N^{13}(t_{\frac{1}{2}} = 10$ min, $I = \frac{1}{2})$ and $C^{11}(t_{\frac{1}{2}} = 20.4$ min, $I = \frac{3}{2})$ were determined from hyperfine structure measurements made with the atomic beam magnetic resonance method. These nuclei are the radioactive members of the $C^{13} - N^{13}$ and $B^{11} - C^{11}$ mirror pairs. The hyperfine structure separation of N^{13} in the atomic ground state, $^4S_{\frac{3}{2}}$, was measured by observing the field-insensitive direct transition $F = 1$, $M_F = 0 \rightarrow F = 2$, $M_F = 0$. Observations of this transition at four different values of the static field yield $|A(N^{13}, {}^4S_{\frac{3}{2}})/h| = 16.673 \pm 0.010$ Mc/sec. When this value is combined with the empirical ratios of g_I/A for both N^{14} and N^{15}, there results $|\mu_1(N^{13})| = 0.32213 \pm 0.00036$ nm. The diamagnetic correction was made in ob-

taining this value. About half of the uncertainty in $\mu_I(N^{13})$ results from the $N^{14} - N^{15}$ hyperfine structure anomaly. The hyperfine constants of C^{11} in the $^3P_2$ atomic state were measured by observing multiple-quantum transitions in the $F = 5/2$ and $F = 7/2$ levels. Four such transitions were seen at a static field of ≈ 17 gauss. Two of the transitions were pulled. The other two, one in each F-level, were used with a theoretical value of g_I to obtain $|A(C^{11}, {}^3P_2)/h| = 68.16 \pm 0.50$ Mc/sec and $|B(C^{11}, {}^3P_2)/h| = 4.8 \pm 1.1$ Mc/sec with $A/B > 0$. No empirical value of g_I/A is available. A calculation of the hyperfine constants using the projection of the UHF function was carried out by C. M. Moser. This calculation yields, for the above values, $|\mu_I(C^{11})| = 0.959 \pm 0.007$ nm and $|Q_I(C^{11})| = 0.030 \pm 0.007$ b, with $\mu_I/Q_I < 0$. The quoted uncertainties are only those due to the uncertainties in the measured values of A and B. Moser estimates that the uncertainty in his calculation is not greater than 2%. The moments of N^{13} and C^{11} are discussed in the light of the intermediate coupling shell model. The $B^{11} - C^{11}$ pair is the only mirror pair for which both quadrupole moments have been determined. The theory of hyperfine structure and the atomic beam magnetic resonance method are reviewed as a prelude. Experimental and theoretical shapes of resonance lines for $\Delta M_F = 0$ transitions are also presented. 114 references. (auth)

15258 (TID-16463) POLARIZATION OF PROTONS FROM THE $He^3(d,p)He^4$ REACTION. R. I. Brown and W. Haeberli (Wisconsin. Univ., Madison). [1961]. Contract [AT(11-1)-Gen-7]. 37p.

The polarization of protons from the $He^3(d,p)He^4$ reaction was measured at eight laboratory angles between 20 and 140° for six deuteron energies from 3 to 12 Mev. The polarization was determined by scattering the protons from carbon. For all energies measured the polarization is positive at forward angles with a maximum near a laboratory angle of 30°. The polarization passes through zero in the vicinity of 60° and has a broad peak of negative polarization at back angles. At the forward maximum the polarization increases with bombarding energy from +0.01 ± 0.03 at 3 Mev to +0.76 ± 0.03 at 10 Mev, and +0.73 ± 0.04 at 12 Mev. The broad minimum in the polarization at larger angles shows a similar energy dependence, but the minimum also shifts to larger angles with increasing deuteron energy. The most negative value of the polarization ($P = -0.66 \pm 0.05$) was found at 120° and 8 Mev. The present measurements suggest that the $He^3(d,p)He^4$ reaction may be a useful source of 23-29 Mev polarized protons. The results are compared with measurements of the neutron polarization in the mirror reaction $T(d,n)He^4$. Some new information of the polarization in the scattering of protons from carbon has also been obtained. 30 references. (auth)

15259 (TID-17089(Pt. I)) TABLES OF DIRECTIONAL CORRELATION ATTENUATION COEFFICIENTS FOR COMBINED MAGNETIC DIPOLE AND RANDOMLY ORIENTED ELECTRIC QUADRUPOLE INTERACTIONS. PART I. SPIN OF INTERMEDIATE NUCLEAR STATE I = 1 AND I = 2. R. M. Steffen (Purdue Univ., Lafayette, Ind.); E. Matthias, and W. Schneider (Uppsala Univ.). Oct. 1962. Contract AT(11-1)-123. 239p.

Differential and integral attenuation coefficients that account for perturbations resulting from interactions of nuclear moments with extranuclear fields in radiations involving intermediate nuclear states have been calculated. The equations for the coefficients that permit rapid computation of angular correlations for successive radiations are derived, and parameters used in the calculations are given. Values for the states I = 1 and I = 2 are given. (D.C.W.)

15260 (TID-17089(Pt. II)) TABLES OF DIRECTIONAL CORRELATION ATTENUATION COEFFICIENTS FOR COMBINED MAGNETIC DIPOLE AND RANDOMLY ORIENTED ELECTRIC QUADRUPOLE INTERACTIONS. PART II. SPIN OF INTERMEDIATE NUCLEAR STATE $I = 3/2$ AND $I = 5/2$. R. M. Steffen (Purdue Univ., Lafayette, Ind.); E. Matthias, and W. Schneider (Uppsala Univ.). Oct. 1962. Contract AT(11-1)-123. 239p.

Differential and integral attenuation coefficients that account for perturbations resulting from interactions of nuclear moments with extra-nuclear fields in radiations involving intermediate nuclear states $I = 3/2$ and $I = 5/2$ have been calculated. The equations for the coefficients that facilitate computation of angular correlations for successive radiations are derived, and parameters used in the calculations are given. (D.C.W.)

15261 (TID-18057) THE ELASTIC SCATTERING OF DEUTERONS BY OXYGEN SIXTEEN (thesis). Carleton Haddock Jones, Jr. (Ohio State Univ., Columbus). 1961. Contract [AT(11-1)-605]. 57p.

The absolute differential cross sections for the elastic scattering of deuterons by O^{16} were measured at deuteron energies from 0.65 Mev to 1.65 Mev at 90°, from 0.65 Mev to 1.85 Mev at 125.3° and 140.8°, and from 0.65 Mev to 2.1 Mev at 166.2°. Apparatus is described, and the cross sections obtained are displayed and compared with the Rutherford cross section. Sources of possible errors are discussed, and two checks for large systematic errors are described. The $He^4(d,d)He^4$ and the $Ar^{40}(d,d)Ar^{40}$ cross sections were measured, and the good agreement with the Rutherford cross sections indicates such errors are absent. (D.C.W.)

15262 (TID-18062) LOW TEMPERATURE NEUTRON PHYSICS STUDIES. Progress Report, February 1, 1962–February 1, 1963. C. G. Shull (Massachusetts Inst. of Tech., Cambridge). Feb. 13, 1963. Contract AT(30-1)-3031. 7p.

Alterations on the liquid helium transfer system for cooling crystals in the vertical field electromagnet permit continuous operation for up to a day and a half and maintenance of temperature at 2.85°K within ±0.03°K for the storage life. An induction furnace recently installed permits growth of pure palladium and 99% Pd–1% Fe single crystal ingots. Polarized neutron scattering studies of vanadium reveal that a field of 22 K gauss will induce an atomic magnetic moment of 0.0010 Bohr magnetons/atom, leading to a magnetic form factor of the resultant magnetic scattering that is characteristic of 3d electrons. Assumption that the paramagnetic susceptibility is due to 3d orbital magnetization and a smaller 3d spin magnetization gives good agreement with theory. Paramagnetic and electronic polarization are both noted to be temperature independent to 15°K. Below 15°K with an applied field of 13.2 K gauss, additional polarized neutron scattering effects develop due to nuclear polarization with a consequent change in the coherent nuclear scattering amplitude of vanadium. Failure of the polarization ratio to go to unit value as the field goes to zero in electronic polarization studies of vanadium reveals the existence of a neutron spin-orbit interaction. Experimental and theoretical evidence for the interaction is noted. (D.C.W.)

15263 (UCRL-3827) MEASUREMENT OF THE SLOW NEUTRON ABSORPTION CROSS SECTION OF SOME HEAVY ISOTOPES. Spofford Grady English (Oklahoma. Univ., Norman). [nd]. Contract [W-7405-eng-48]. 21p.

Thesis submitted to University of California, Berkeley.

Apparatus and procedure used in measuring the fission cross section of Pu^{239} for slow neutrons, relative to the

cross section of U^{235}, is described. A value of 2 is recorded for the ratio. The technique used in searching for spontaneous fission in 50 yr Pu^{238} is also described. No spontaneous fission was observed, and the spontaneous rate implies a half life of more than 10^{10} yr for this process. Yields of Np and Pu from deuteron bombardment of U are examined to determine whether 50 yr Pu is formed in a (d,2n) reaction. Yield measurements at varying deuteron energies reveal the 50 yr Pu to be produced from a different reaction than that producing Np^{239} and Pu^{239}. The (d,2n) reaction seems to account for the formation. The half life of Pu^{239} is also estimated to be 18,300 yr. Experiments on the volatility of Pu as a bromide, chloride, and oxide from aqueous solutions reveal no volatility. Similar results are reported for dry distillation experiments. (D.C.W.)

15264 (UCRL-10321) HYPERFINE STRUCTURES AND NUCLEAR MOMENTS OF Lu^{176m}, Br^{80}, Br^{80m}, AND I^{132} (thesis). Matthew B. White (California. Univ., Berkeley. Lawrence Radiation Lab.). Sept. 1962. Contract W-7405-eng-48. 153p.

The method of atomic-beam radiofrequency spectroscopy was used to determine some nuclear and atomic properties of Lu^{176m}, Br^{80}, Br^{80m}, and I^{132}. Hyperfine structure measurements were made to determine the magnetic dipole interaction constants and the electric quadrupole interaction constants of all these isotopes. Also the nuclear spin and the electronic g_J factor were measured for Lu^{176m}, and the nuclear magnetic dipole moments and the electric quadrupole moments for the isotopes were calculated. All results are listed. 62 references. (auth)

15265 STUDY OF THE CASCADE DEEXCITATION OF Sn^{115} FROM THE $In^{115}(p,n)$ REACTION. E. Ivanov, N. Martalogu, D. Ploştinaru, A. Alevra, and R. Dumitrescu (Inst. of Atomic Physics, Bucharest). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 13: 675-86(1962). (In Rumanian)

The existence of a 114 to 500-kev cascade resulting from the $In^{115}(p,n)Sn^{115}$ reaction was shown using a fast-slow coincidence scheme ($\tau = 10^{-7}$ sec). By using a pulsed proton beam, the pulses with a duration of 0.4 μsec being succeeded by a cadence of 380 pulses/sec, it was found that the mean life of this cascade is approximately 40 μsec, which indicates the presence of an isomeric state of Sn^{115}. The experimental results are discussed and interpreted from the point of view of the shell model. (tr-auth)

15266 EFFECT OF THE NUCLEAR POTENTIAL FORM ON THE SUBBARRIER TRANSFER OF A NEUTRON. J. Grabowski and B. N. Kalinkin (Joint Inst. of Nuclear Research, Dubna, USSR). Acta Phys. Polon., 22: 441-3(Nov. 1962). (In English)

The reaction $N^{14} + N^{14} \rightarrow N^{13} + N^{15}$ is considered. The binding energy of the most weakly bound neutron in N^{14} is -10.5 Mev. The cross sections for the reaction are calculated at 10 and 15 Mev incident N^{14} energy, using a Saxon-Woods nuclear potential. The results are compared with experimental and square-well calculated cross sections at these energies, and it is found that the difference between the square-well and Saxon-Woods results is quite small, and that both theoretical models disagree with experiment. (T.F.H.)

15267 INTERACTIONS OF A BEAM OF He^3 PARTICLES OF 28.5 Mev WITH CS_2. J. Catalá, A. García, and J. de la Rubia (Facultad de Ciencias, Valencia). Anales Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 58: 227-32(July-Aug. 1962). (In Spanish)

Interactions of a 28.5-Mev He^3 particle beam with CS_2 vapor targets were carried out using the photographic plate method. Differential cross sections for the elastic scattering of He^3 by S^{32} were measured, and some evidence of inelastic processes of scattering by S^{32} and C^{12} was found. (auth)

15268 SCATTERING OF 29-Mev He^3 PARTICLES BY H^1 AND H^2. A. García, G. Pardo, and P. Tárrega (Facultad de Ciencias, Valencia). Anales Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 58: 233-8(July-Aug. 1962). (In Spanish)

Absolute differential cross sections for the elastic scattering of 29-Mev He^3 particles by H and D were measured using the photographic plate method. The He^3–H angular distribution was compared with theoretical predictions based on resonating group theory. (auth)

15269 ENERGY LEVELS IN N^{14} PERTAINING TO THE RATIO C^{12}/C^{13} PRODUCED IN THE CNO CYCLE. Ronald E. Brown (Univ. of Washington, Seattle). Astrophys. J., 137: 338-41(Jan. 1963).

Due to the effect a 7.6-Mev resonant level in the reaction $C^{13}(p,\gamma)N^{14}$ would have on the rate of C^{13} destruction in the CNO cycle, the reaction is studied with 10.5-Mev protons. Evidence for non-existence of the 7.6-Mev level is found, and it is concluded that in the stellar energy region no resonance exists in the reaction. (D.C.W.)

15270 INVESTIGATION OF 5.5 HOURS ^{180m}Hf ISOMERIC STATE DECAY. S. D. Koički, A. H. Kukoč, M. P. Radojević, and J. M. Simić. Bull. Inst. Nucl. Sci. "Boris Kidrich" (Belgrade), 13: No. 3, 1-13(Oct. 1962). (In English)

The angular correlations (gamma-gamma) of the 501-332 kev, 443-332 kev, 57-443 kev cascades were measured. On the basis of these measurements the spin of the metastable state was fixed as 8^- and the multipolarities of 57 kev and 501 kev transitions were determined. The cross section for forming Hf^{180m} was measured, and the limit of the 834 kev transition intensity was found. (auth)

15271 MULTIPOLARITIES OF THE 72 kev AND THE 134 kev TRANSITIONS IN ^{187}Re. R. Stepić and M. Mladjenović. Bull. Inst. Nucl. Sci. "Boris Kidrich" (Belgrade), 13: No. 3, 15-20(Oct. 1962). (In English)

The L internal conversion lines were measured in a 50-cm iron-free double focussing spectrometer. It was found from the L sub-shell ratios that the 72-kev transition is a pure E1 transition without any anomalous conversion observed, while the 134-kev transition is an M1 transition with a $1.8 \pm 0.5\%$ admixture of E2. (auth)

15272 PRODUCTION OF 28-Mev NEUTRONS AND METHOD FOR THE MEASUREMENT OF TOTAL CROSS SECTIONS. G. Deconninck, A. Gonze, P. Macq, and J. P. Meulders. Bull. Soc. Belge Phys., No. 9, 530-4(1961). (In French)

The details and geometry of the tritium target used for the production of 28-Mev neutrons from the deuteron beam extracted from the Louvain cyclotron are discussed and shown schematically. The total cross section measurements were made using the transmission method. The values obtained for Al, Mg, Zn, As, S, P, Na, and I are tabulated. The experimental values for P^{31} were compared with the theoretical values obtained by the Bjorklund and Fernbach model and the square well model. (J.S.R.)

15273 STUDY OF THE ANGULAR DISTRIBUTION OF THE α PARTICLES PRODUCED BY THE REACTION OF LITHIUM-6 NUCLEI PROJECTED AGAINST LITHIUM-6 NUCLEI. Mireille Coste (Faculté des Sciences, Bordeaux and Centre d'Études Nucléaires, Saclay, France). Compt. Rend., 255: 2750-2(Nov. 19, 1962). (In French)

The angular distribution of α particles from the reaction $Li^6 + Li^6 \rightarrow \alpha + Be^8$ associated with Be^8 nuclei in their ground state was studied. This distribution has a very sharp peak at 90°. (tr-auth)

15274 THE SEPARATION OF THE MEMBERS OF THE DOUBLET OF DEFORMED ODD-ODD NUCLEI. Alceu de Pinho (Laboratoire Joliot-Curie de Physique Nucléare, Orsay, France and Centro Brasileiro de Pesquisas Físicas, Rio de Janeiro). Compt. Rend., 255: 2911-13(Nov. 26, 1962). (In French)

The elements of the diagonal matrix of a neutron-proton central interaction is calculated so that the separation of the members $K = \Omega = \Omega_p + \Omega_n$ and $K' = \Omega' = \Omega_p - \Omega_n$ of the doublet resulting from the coupling of the last proton with the last neutron can be calculated. The degeneration of the doublet is raised by a residual force p–n dependent on spin. (tr-auth)

15275 STUDY OF THE EXISTENCE OF THE 1.33-Mev LEVEL OF MAGNESIUM-26. Jean Depraz, Bernard Duborgel, Gerard Grenier, and Raymond Salin (Institut de Physiaue Nucleaire, Lyon). Compt. Rend., 255: 2938-40 (Nov. 26, 1962). (In French)

A new level at 1.33 Mev was recently announced by G. Dearneley and A. T. G. Ferguson. A study of the reactions $Si^{29}(n,\alpha)Mg^{26}$ with 14-Mev neutrons has confirmed the existence of this level. (tr-auth)

15276 CONTRIBUTION OF A BIPION AND A TRIPION TO THE NUCLEAR POTENTIAL IN NON-LOCAL THEORY. Michel de Celles. Compt. Rend., 256: 603-5(Jan. 14, 1963). (In French)

The contribution of vector mesons to nuclear forces was calculated in the Heitler-Arnous non-local theory. Added to that of the pion, it gives a potential capable of being applied to the deuteron and to N-N scattering. (tr-auth)

15277 NUCLEAR EVAPORATION. U. Facchini (CISE, Milan and Università, Milan). Energia Nucl. (Milan), 9: 581-94(Oct. 1962). (In Italian)

The validity of the evaporation model is discussed. In the first part, the basic laws of evaporation are compared with a group of experimental results and the level density parameters are analyzed. In the second part, the problem of fluctuations in evaporation is discussed in connection with recent results obtained by Colli and coworkers. It is demonstrated that the "basic laws" of Weisskopf and the theoretical conclusions of Ericson on the fluctuations are well verified in a wide group of reactions and in a wide range of energies. (auth)

15278 THE MAGNETIC MOMENTS OF EXCITED ATOMIC NUCLEI. E. Bodenstedt (Universität, Hamburg). Fortschr. Physik, 10: 321-88(1962). (In German)

All known results from the measurement of the magnetic moments of excited nuclei are described and critically evaluated with respect to systematic error sources. An interpretation of the magnetic moments in the corresponding nuclear model was attempted. (J.S.R.)

15279 PERIODICITY AND STRUCTURAL DEVELOPMENT IN NUCLEI. A. K. Dutta, B. Pal, A. Das Gupta, and N. Chaudhury (Calcutta Univ.). Indian J. Phys., 36: 497-506(Oct. 1962).

The deviations of the stable nuclear masses from the Bethe-Weiszacker relation were determined with the help of constants previously determined by Green (1954) as well as by a new set of constants determined now. The masses were taken from Everlings (1960) data. The deviations fall on a number of periodic curves connected through the isotopes on an excess neutron basis. The minima of the periodic curves show a nearly constant charge variation, and a liquid crystal structure was suggested for the nuclei, composed of different subgroups of elementary nuclei Li, Be, and B. The number of subgroups in a composite structure explains the observed periodicity. The cohesion energy between the subgroups obtains a nearly constant value per unit. (auth)

15280 THE TOTAL CROSS-SECTIONS FOR THE NUCLEAR SCATTERING OF HIGH ENERGY NUCLEONS. G. Z. Shah and B. M Thaker (Bhavan's Coll., Bombay). Indian J. Phys., 36: 595-9(Nov. 1962).

Using the characteristic nuclear density distribution for light elements, an expression for the total cross section is derived. The parameters of the complex refractive index are determined from a hard-core-nucleon model and the cross sections for (n,n) and (n,p) scattering respectively. Using these parameters, theoretical values of total cross sections are calculated for all the light elements for energies between 200 and 1400 Mev. These values of σ_t are then compared with the experimental values of σ_t at the corresponding energies. Agreement is obtained between the theoretical and experimental total cross sections. (auth)

15281 QUADRUPOLE AND FORBIDDEN LINES IN THE L-EMISSION SPECTRUM OF RHENIUM-75. B. G. Gokhale and K. S. Srivastava (Univ. of Lucknow, India). Indian J. Pure Appl. Phys., 1: 14-19(Jan. 1963).

A detailed study of the quadrupole and forbidden lines in the L-emission spectrum of rhenium, using a 40-cm curved crystal transmission spectrograph, revealed the existence of four new diagram lines at 1575.6, 1514.7, 1333.8, and 1081.7 X. U. The first two are assigned to the quadrupole transitions $L_{III}M_{II}$ (t) and $L_{III}M_{III}$ (s) while the last two correspond to the forbidden transitions $L_{II}M_{II}$ and $L_{II}N_{II}$, respectively. Measurements on the previously known quadrupole and forbidden lines were compared with those of the earlier workers. The discrepancy in the wavelength of the quadrupole line $L_{III}N_{VI,VII}$ (β_3') as measured by the different ones is discussed. (auth)

15282 QUADRUPOLE AND FORBIDDEN LINES IN THE L-EMISSION SPECTRUM OF IRIDIUM-77. A. N. Nigam (Univ. of Lucknow, India). Indian J. Pure Appl. Phys., 1: 53-55(Feb. 1963).

The L-emission spectrum of iridium was investigated using a 40-cm curved mica crystal spectrograph of the transmission type. Two new diagram lines at 1204.5 and 1247.6 X. U. corresponding respectively to the quadrupole transition $L_{II}M_{III}$ (β_{17}) and the forbidden transition $L_{II}M_{II}$ are reported. The presence of the quadrupole line t (1489.94 X. U.) corresponding to the transition $L_{III}M_{II}$ was conclusively established. The results obtained on previously known quadrupole and forbidden lines were compared with those of others. (auth)

15283 QUADRUPOLE AND FORBIDDEN LINES IN THE L-EMISSION SPECTRUM OF TANTALUM-73. B. G. Gokhale and A. N. Nigam (Univ. of Lucknow, India). Indian J. Pure Appl. Phys., 1: 56-8(Feb. 1963).

The L-emission spectrum of tantalum was studied using a 40-cm curved mica crystal spectrograph of the transmission type. Two new diagram lines at 1383.53 and 1157.6 X. U. are reported. The first was assigned to the quadrupole transition $L_{II}M_{III}$ (β_{17}) and the second to the forbidden transition $L_{II}M_{II}$. (auth)

15284 SOME INVESTIGATIONS ON THE PREPARATION OF Na^{22} FROM MAGNESIUM. K. Wagner (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 5: 790-6(Oct.-Nov. 1962). (In German)

Sodium-22(1.6 mc/mamp hr) was formed by irradiation of magnesium targets with 13.5-Mev deuterons in the Rossendorf cyclotron. The magnesium was separated in two stages from the Na^{22}. The principal amount (gram quantities) was precipitated as $Mg(NH_4)_2(CO_3)_2 \cdot 4H_2O$; from the remaining few milligrams, the carrier-free Na^{22} was collected by electrolytic precipitation on a mercury cathode. A study was made on the dependence of the separation effect on the quantity of magnesium, the precipitation conditions for the first stage, the addition of sodium as carrier, and the length of electrolysis for the second stage. By the utilization of quartz vessels for the evaporation process, the loss by adsorption of Na^{22} on the vessel walls could be greatly reduced. Yields above 95% were easily obtainable for the separation. Some 100 μc Na^{22} could be produced for each irradiation. (tr-auth)

15285 NEUTRON CAPTURE IN THE SAMARIUM ISOTOPES AND THE FORMATION OF THE ELEMENTS OF THE SOLAR SYSTEM. R. L. Macklin, J. H. Gibbons, and T. Inada (Oak Ridge National Lab., Tenn.). Nature, 197: 369-70(Jan. 26, 1963).

Neutron capture measurements for the isotopes of Sm are reported at 30 kev. Samples of electromagnetically separated Sm isotopes as Sm_2O_3 were used with a 3-Mv pulsed Van de Graaff providing neutrons via the $Li^7(p,n)$ reaction. The capture γ rays were measured. Results provide some constraints for nucleosynthesis models. (C.H.)

15286 DIFFERENTIAL CROSS SECTIONS FOR D-T NEUTRONS BY TIME OF FLIGHT METHODS. J. Rethmeier, C. C. Jonker, M. Rodenburg, J. W. Hovenier, and D. R. v. d. Meulen (Vrije Universiteit, Amsterdam). Nucl. Instr. Methods, 17: 273-85(Dec. 1962). (In English)

A time-of-flight experiment using the associated particle method is performed with d-t neutrons scattered from carbon and bismuth. The time resolution is 0.75 nsec, with an electronic efficiency of 85%. From the results, conclusions are drawn concerning the usefulness of the method to measure elastic and inelastic scattering of d-t neutrons, and concerning improvements of the method. A detailed comparison is made between the pulsed-source and associated particle methods. The difficulties of the corrections for multiple scattering are discussed. (auth)

15287 APPARATUS AND METHODS USED IN A SLOW NEUTRON RESONANCE SCATTERING EXPERIMENT. H. Ceulemans, M. Nève De Mévergnies, and F. Poortmans (Studiecentrum voor Kernenergie, Mol, Belg.). Nucl. Instr. Methods, 17: 342-52(Dec. 1962). (In English)

A slow-neutron crystal spectrometer and a scattering chamber for resonance scattering experiments are described. The purpose of the experiment is to measure Γ_n/Γ by observing the scattering rate from a thin sample of known transmission. A method is developed for correcting the observed rate for the effects of absorption after scattering and resolution broadening. In order to check the method, Γ_n/Γ for the 1.46-ev resonance in In^{115} + n is measured and a value of 0.041 ± 0.001 found. From this result a resonance spin J = 5 may be inferred, using total cross section data. This spin value is in agreement with results obtained by different methods. (auth)

15288 THE EFFECT OF TARGET THICKNESS AND BEAM STRAGGLING ON THE MAGNITUDE OF RESONANCES IN ELASTIC SCATTERING EXPERIMENTS. J. A. Weinman (Argonne National Lab., Ill.). Nucl. Instr. Methods, 21: 181-2(Jan. 1963). (TID-17506). (In English)

Calculations are made on the effect of spread due to target thickness and beam straggling on the magnitude of a resonance in elastic scattering. A Lorentzian function with an effective target thickness is used to represent the spread. The shapes of the calculated resonances have the same qualitative features as the resonances derived from dispersion theory. Total resonance widths are tabulated for alpha resonances in Si^{28}. (D.L.C.)

15289 HALF-LIVES OF FIRST EXCITED 2^+ STATES ($150 < A < 190$). D. B. Fossan and B. Herskind (Universitet, Copenhagen). Nucl. Phys., 40: 24-33(Jan. 1963). (In English)

The half lives of the first excited 2^+ states of the following even nuclei in the region $150 < A < 190$ are measured with a fast time-to-height converter: Sm^{152}; Gd^{154}; Gd^{156}; Dy^{160}; Er^{164}; Er^{166}; Yb^{170}; Hf^{176}; Hf^{178}; W^{182}; Os^{186}; and Os^{188}. Experimental total internal-conversion coefficients for these transitions are calculated from the lifetime measurements and inelastic-scattering Coulomb-excitation B(E2) values. Comparisons are made with theoretical internal-conversion coefficients, which imply $\alpha_{exp.}/\alpha_{theor.} > 1$ for these deformed nuclei by an average value of 12%. (auth)

15290 SPIN AND PARITY OF CERTAIN LEVELS IN S^{32} BY ANALYSIS OF THE SCATTERING $P^{31}(p,p)P^{31}$. J. Cohen-Ganouna, M. Lambert, and J. Schmouker (Ecole Polytechnique, Paris). Nucl. Phys., 40: 67-81(Jan. 1963). (In French)

Differential cross sections for the elastic scattering of protons from P^{31} were measured for the center-of-mass scattering angles 165° 29′, 143° 40′, 125° 15′, and 91° 45′, for laboratory proton energies between 1 and 2 Mev. These data were analyzed in terms of the single-level approximation of the dispersion theory. The results yielded the following resonance energies (Mev) and spin and parity assignments for the levels of the compound nucleus S^{32}: 1.254(2^-), 1.521(1^-), 1.591($0^{(-)}$) and 1.904(1^-). A (probably) double resonance at E_p = 1.724 and 1.740 kev was not analyzed. (auth)

15291 REACTIONS $A^{40}(pp)A^{40}$ AND $A^{40}(p\gamma)K^{41}$ DETERMINATION AND STUDY OF CERTAIN EXCITED STATES OF K^{41}. J. Cohen-Ganouna, M. Lambert, and J. Schmouker (Ecole Polytechnique, Paris). Nucl. Phys., 40: 82-92(Jan. 1963). (In French)

The $Ar^{40}(p\gamma)K^{41}$ reaction is studied in the range of proton energies from 1 to 1.65 Mev, using a thin target of natural argon gas. Seventy excited levels in K^{41} are observed. Differential cross sections for the elastic scattering of protons from Ar^{40} are measured for the center of mass scattering angles 166° 00, 141° 50′, and 125° 16′ for laboratory proton energies between 1 and 1.95 Mev. These data are analyzed in terms of the single-level approximation of the dispersion theory. The results yield the following resonance energies (Mev) and assignment of spin and parity for the compound nucleus K^{41}: 1.875 ($^5/_2^-$) and 1.890 ($^9/_2^-$). (auth)

15292 COLLECTIVE DIPOLE EXCITATIONS OF ATOMIC NUCLEI. V. V. Balashov (Moscow State Univ.). Nucl. Phys., 40: 93-106(Jan. 1963). (In English)

The principal properties of the collective dipole excitations of nuclei are discussed. The effect of residual nucleon-nucleon interactions, nuclear superfluidity, phonon (surface) excitations, etc. on the giant-resonance photoabsorption characteristics is considered. (auth)

15293 ENERGY LEVELS OF As^{77}. R. G. Arns (Univ. of Buffalo), C. H. Chen, R. E. Sund, and M. L. Wiedenbeck. Nucl. Phys., 40: 132-8(Jan. 1963). (In English)

The gamma rays of As^{77} following beta decay of Ge^{77} ($\tau_{\frac{1}{2}}$ = 11.3 hours) are investigated using coincidence tech-

niques. Complexity is found in the level structure above 2 Mev. Relative intensities of the gamma transitions are reported. (auth)

15294 SECOND FORBIDDEN COULOMB BETA TRANSITIONS. Milan Vinduška (Nuclear Research Inst., Czechoslovak Academy of Sciences, Rez). Nucl. Phys., 40: 162-6(Jan. 1963). (In English)

Second-forbidden Coulomb beta transitions are investigated, and it is shown that the shape of the second-forbidden Coulomb beta spectrum is similar to that of unique first forbidden transitions, and that, e.g., transitions in Tc^{99}, I^{129}, and Cs^{135} may be interpreted as Coulomb transitions. Experiments are discussed that could verify this assumption. (auth)

15295 FURTHER REMARKS ON ENERGY LEVEL SPACINGS. Charles E. Porter (Brookhaven National Lab., Upton, N. Y.). Nucl. Phys., 40: 167-76(Jan. 1963). (BNL-6260) (In English)

A discussion is given of the next-nearest-neighbor energy-level spacing distribution. A unified approach to the discussion of the class of all quantal measuring devices with the same mean level density is presented. Some remarks concerning number operator ensembles are included. (auth)

15296 THOMAS'S CLASSICAL THEORY OF SPIN. H. Bacry (Faculté des Sciences, Marseille). Nuovo Cimento (10), 26: 1164-72(Dec. 16, 1962). (In English)

The equivalence of Thomas' classical theory of spin and the Bargmann-Michel-Telegdi equation are presented. (auth)

15297 A COMPARISON OF THE PRODUCTION OF PIONS AND HYPERONS IN NUCLEAR INTERACTIONS OF VERY HIGH ENERGY. M. G. Bowler, P. H. Fowler, and D. H. Perkins (Univ. of Bristol, Eng.). Nuovo Cimento (10), 26: 1182-96(Dec. 16, 1962). (In English)

Recently, it was suggested that in nuclear collisions at ultra-high energies (>10^4 Bev), the production of hyperons, carrying a large part of the primary energy, may become a frequent process. The high-energy pion flux in the atmosphere may then be dominated by pions from decay in flight of such hyperons, rather than pions created directly in the collisions (pionization). This hypothesis was examined in the light of our data on the frequency of soft cascades produced in emulsion, heavy element stacks flown at aircraft altitudes. It is shown that the high-energy pion flux can be well accounted for in terms of direct pion production. The flux from the latter process is always of the same order as, or greater than, the maximum possible pion flux from hyperon decay. Our results at these high energies are consistent with a production probability of hyperons, carrying a large part of the primary energy, no greater than the value observed (~5%) at accelerator energies (25 Bev). (auth)

15298 SCATTERING OF μ-MESONS BY COPPER NUCLEI. S. N. Sen Gupta and M. S. Sinha (Bose Inst., Calcutta). Nuovo Cimento (10), 26: 1279-91(Dec. 16, 1962). (In English)

An experimental study of the scattering of μ mesons by $\frac{1}{4}$ inch copper plates was made in the momentum interval $40 < p\beta < 170$ Mev/c by using a multiplate cloud chamber. The μ mesons were identified by their decay produced inside the cloud chamber, and their momenta were individually estimated from the residual ranges after scattering. The triggering system was such that there was no bias in recording large angle events. Altogether 2,606 scatterings were analysed and the resulting scattering distributions were found to agree satisfactorily with the distributions calculated on the basis of a purely electromagnetic interaction between the μ-meson and the nucleus. (auth)

15299 CROSS-SECTION MEASUREMENT OF (n,2n) REACTIONS ON 14.1 Mev NEUTRONS. M. Cevolani and S. Petralia (Istituto Nazionale di Fisica Nucleare, Bologna). Nuovo Cimento (10), 26: 1328-38(Dec. 16, 1962). (In English)

The absolute cross section of the reaction (n,2n) were measured in twelve nuclei having β^+ residual activity, using neutrons of 14.1 Mev. The results are compared with data existing in the literature and are discussed with reference to the theory of Weisskopf and Ewing. (auth)

15300 ANALYSIS OF INELASTIC COLLISION π^- + C AT 915 Mev. S. Mongelli (Università, Bari), A. Romano, P. Waloschek, A. Gentile, and E. Perez-Ferreira. Nuovo Cimento (10), 26: 1368-75(Dec. 16, 1962). (In English)

A calculation of some predictions of the independent particle model is described and compared with the experimental results on inelastic events occurring in the collision of π^- mesons on carbon nuclei, at the kinetic energy of 915 Mev. The experimental data are well described by the independent particle model when the inelastic pion-nucleon cases are assumed to be dominated by the $\frac{3}{2}, \frac{3}{2}$ resonance and the possibility of a second interaction of the pion within the nucleus is taken into account. (auth)

15301 CROSS-SECTION FLUCTUATIONS IN THE $^{28}Si(\gamma,p)$ REACTION AT 17.6 Mev. P. G. Bizzeti, A. M. Bizzeti-Sona, M. Bocciolini, G. Di Caporiacco, and M. Mandò (Università, Florence and Istituto Nazionale di Fisica Nucleare, Florence). Nuovo Cimento (10), 26: 1412-15(Dec. 16, 1962). (In English)

Results of preliminary experiments on the $Si^{28}(\gamma,p)$ and $Si^{28}(\gamma,\alpha)$ reactions with a γ energy ~17.6 Mev were reported. A proton beam of ~470 kev was made to impinge on a thick natural lithium target. A silicon detector served both as target for the γ radiation and as detector for the charged particle products. In the explored range of 100 kev strong cross section fluctuations occurred. (C.E.S.)

15302 THE ^7Li + p γ-RADIATION AS A TOOL FOR THE DETECTION OF NUCLEAR CROSS-SECTION FLUCTUATIONS. M. Mandò (Università, Florence and Istituto Nazionale di Fisica Nucleare, Florence). Nuovo Cimento (10), 26: 1416-18(Dec. 16, 1962). (In English)

Advantages offered by the γ radiation from Li^7 + p reaction when used as a projectile for nuclear cross section fluctuations were pointed out. Specific experiments of this type started at Florence and Bologna were discussed. (C.E.S.)

15303 NOTE ON PRIMAKOFF'S FORMULA. H. G. Wahsweiler (Universität, Freiburg i. B.). Nuovo Cimento (10), 26: 1419-21(Dec. 16, 1962). (In English)

A mathematical method was developed to indicate the nuclear surface effect of the muon capture rate in Ca^{40}. This surface effect was not implied in Primakoff's theory of muon capture. (C.E.S.)

15304 INTERNAL CONVERSION COEFFICIENTS OF THE $2^+ \rightarrow 0^+$ PURE E2 TRANSITIONS IN ^{166}Er, ^{170}Yb, AND ^{186}Os. M. S. El-Nesr and E. Bashandy (Univ. of Uppsala). Physica, 28: 1335-40(Dec. 1962). (In English)

The internal conversion coefficients of the 80.3, 84, and 137 kev pure E2 transitions in Er^{166}, Yb^{170}, and Os^{186} respectively were measured by means of the electron-electron coincidence method. The results obtained were in agreement with theoretical values for pure E2 transitions. (auth)

15305 RADIOCHEMICAL STUDIES OF TANTALUM DEEP SPALLATION AND FISSION BY 680-Mev PROTONS. V. I. Baranovskii, A. N. Murin, and B. K. Preobrazhenskii. Radiokhimiya, 4: 470-9(1962). (In Russian)

Radiochemical studies were made of tantalum spallation by 680-Mev protons and of the effects produced by closed nucleon shells on the yield of nuclear reaction products. The yield and cross sections of fission products were also analyzed and tabulated. The total Ta fission cross section was 8 ± 2.5 mb. The maximum yield was found at mass numbers 79 to 80. The most probable Z for the above masses is 34.5 to 35, which indicates Tm and Y with 158 and 160 mass numbers as the most probable fissioning nuclei. (R.V.J.)

15306 PARTIAL YIELDS OF ISOBARS WITH A MASS NUMBER OF 138. A. N. Apollonova, I. T. Krisyuk, and V. N. Ushatskiĭ. Radiokhimiya, 4: 711-14(1962). (In Russian)

The partial yields of the 3 isobars with a mass number of 138, formed in the fission process of U^{238} induced by 14-Mev neutrons, were determined by means of a previously described method (Radiokhimiya, 4: 587(1962) No. 5), based on the removal of Xe during the irradiation from the solution and collecting the gas in a cold trap at −197°C. The activity of the last unstable member of the decay chain I_{53}^{138} (5.9 sec) → Xe_{54}^{138} (17 min) → Cs_{55}^{138} (32.5 min) → Ba_{56}^{138} (stable) was used in the measurements which included two separate series. The determination of the partial yield of Cs^{138} with respect to the whole yield involved the irradiation of a uranyl nitrate solution with 14-Mev neutrons through a Cs carrier; the partial yield of Cs^{138} was found to be 8.3 ± 5%. In a second series, the yields of Xe^{138} and I^{138} were measured on the basis of the Cs^{138} from the cold traps; their values were 36.7 and 55%, respectively. The contribution of Te^{138} to the total yield was calculated at about 12% from the charge distribution; on this basis it was concluded that the partial yield of I must be about 43%. The peak of the charge distribution was found to differ from the value calculated by the A. C. Pappas' method (First Conference on the Peaceful Uses of Atomic Energy, Geneva, 1955, Vol. 7, 19) by 0.5 charge unit. (TTT)

15307 THE STRUCTURE OF LIGHT NUCLEI. Paul Goldhammer (Univ. of Nebraska, Lincoln). Rev. Mod. Phys., 35: 40-107(Jan. 1963).

Nuclear size parameters, nuclear phenomena, and nuclear interactions are discussed in terms of cluster, shell, liquid drop, and collective representations of nuclei. Results obtained by the several means are evaluated and are compared when possible. The appropriateness of each model for certain applications is also examined. 334 references. (D.C.W.)

15308 SYSTEMATICS OF DEFORMATIONS OF ATOMIC NUCLEI. Eugene Marshalek (Univ. of California, Berkeley), Lucy Wu Person, and Raymond K. Sheline. Rev. Mod. Phys., 35: 108-17(Jan. 1963). (UCRL-10634)

In a search for new regions of nuclear deformation and for theoretical verification of experimentally observed regions, the equilibrium deformations for a large region of the periodic table have been analyzed. The procedure that involves eigenvalues of the Nilsson-model hamiltonian for the self-consistent energies is outlined, and Coulomb and pairing force considerations are discussed. Deformations and energies of deformation are plotted versus neutron and proton numbers. Extended deformation regions are noted where both neutron and proton numbers go from 50 to 82 and where neutron and proton numbers go from 82 to 126. (D.C.W.)

15309 NUCLEAR SHELL THEORY. Amos de-Shalit and Igal Talmi. New York, Academic Press, 1963. 579p. $14.50.

Use of shell models in dealing with interactions in nuclei is mathematically treated, with particular emphasis on the applicability of tensors. (D.C.W.)

15310 RESEARCH TRENDS 1962-1967. NUCLEAR STRUCTURE PHYSICS. NSF-62-45. Washington, D. C., National Science Foundation, [1962]. 46p.

Experimental and theoretical developments give promise of a dramatic improvement in the understanding of nuclear structure. Fundamental ideas about the behavior of nucleons in nuclei are changing. Nuclear forces were formerly assumed to be extremely strong and of very short range. The nucleus was thought of as a collection of billiard balls moving about rapidly and colliding almost instantaneously in much the same fashion as molecules in a liquid drop. It is recognized, however, that the nuclear forces are relatively weak, and the picture of the nucleus which is beginning to emerge is that of a dense core surrounded by a cloud of weakly interacting nucleons. Whereas the old picture of the nucleus cannot be treated theoretically by the methods of mathematical physics, the new concept lends itself to mathematical analysis by familiar methods. It is possible to ask critical questions with some hope that the answers can be calculated. Developments in experimental physics are well ahead of theory, and it is feasible to construct apparatus that enables physicists to answer the critical questions posed by theory. Nuclear structure research enjoyed a steadily increasing level of activity and vigor from 1952 to 1962. The amount of published information and the number of scientific investigators increased markedly. If the United States is to exploit the developments and respond to the demands for the training of young scientists, strongly increased federal support and encouragement are necessary. Recommendations are presented concerning economic support of nuclear research. (auth)

15311 YADERNYE REAKTSII POD DEISTVIEM CHASTITS VYSOKIKH ENERGII. (Effects of High Energy Particles on Nuclear Reactions). N. A. Perfilov, O. V. Lozhkin, and V. I. Ostroumov. Moscow, Publishing House of the Academy of Sciences, 1962. 252p.

Inelastic reactions between high-energy particles and nuclei were analyzed, and theoretical aspects and experimental data on high-energy nuclear reactions are discussed. Optical models, intra-nuclear cascade processes, and the theory of particle evaporation from excited nuclei are also discussed. The results of chemical analysis, nuclear emulsion studies, and counter detection methods are evaluated. (R.V.J.)

Particle Accelerators

Refer also to abstract 14545.

15312 (AEET/NP/5) 5.5 MILLION VOLT VAN DE GRAAFF ACCELERATOR AT TROMBAY. A. S. Divatia, T. G. Varghese, Joseph John, et al. (India. Atomic Energy Establishment, Trombay). 1962. 32p.

Characteristics, design, and operation of a Van de Graaff 5.5-Mev vertical type positive ion accelerator installed at the Atomic Energy Establishment, Trombay are discussed. Results of neutron threshold and gamma resonance experiments performed in calibration of the device and its allied components are given. (D.C.W.)

15313 (BNL-6785) AN EXPERIMENTAL FACILITY: A Mu MESON BEAM OF 1 Bev. R. Cool, E. D. Courant,

and L. Marshall (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract [AT(30-2)-Gen-16]. 11p.

A proposal for production of a high-energy meson (μ) beam at the Cosmotron is discussed. The proposed method involves containing a beam of momentum-analyzed pions in a quadrupole lens system, which extends for a distance equivalent to one pion lifetime at the appropriate velocity, and collecting the decay muons in the same system. At the end of the containment, the decay muons are separated from the remaining pions and at the same time selected in energy by means of a momentum-analyzing magnet. The main features of the lens system and the expected muon beam characteristics are described. (J.R.D.)

15314 (BNL-6794) ALTERNATING GRADIENT MAGNETS. R. A. Beth (Brookhaven National Lab., Upton, N. Y.). Feb. 14, 1963. Contract [AT(30-2)-Gen-16]. 8p.

Alternating gradient focusing is briefly discussed, and several poles that permit maintaining a constant B_y while varying the effective length of the magnet with x are evaluated. (D.C.W.)

15315 (BNL-6808) LONG COIL MEASUREMENTS SATISFY TWO-DIMENSIONAL FIELD EQUATIONS. Internal Report. R. A. Beth (Brookhaven National Lab., Upton, N. Y.). Mar. 1, 1963. Contract [AT(30-2)-Gen-16]. 3p.

In bending magnets, direct measurements of $I_y = I_y(x,y) = \int_{z_1}^{z_2} B_y dz$ prove more useful than detailed measurements of B. A search coil with long and narrow turns is used, and I_x and I_y is shown to satisfy two-dimensional field equations. (D.C.W.)

15316 (BNL-6823) PRODUCTION OF Mu MESON BEAM OF MOMENTUM ABOVE 6.5 Bev/c AT BROOKHAVEN AGS. L. Marshall (New York Univ., New York) and T. Yamanouchi (Rochester, N. Y. Univ.). [Jan. 18, 1962]. Contract [AT(30-2)-Gen-16]. 37p.

The method used in computing the intensity and momentum spectrum of a μ meson beam to be obtained by decays in a pion beam from the Brookhaven AGS is described. Characteristics of the magnets that supposedly will be available are given, and properties of the μ and π fluxes at varying positions are displayed. A total flux of 6.5 Bev/c muons of 9×10^6 per 10^{11} circulating protons is estimated. Extension of the beam transport system to permit more pion decay seems to offer higher muon fluxes and momenta. (D.C.W.)

15317 (CERN-NPA/Int-61-5) A MERCURY SUBPROGRAM FOR HIGH ENERGY BEAM OPTICS. S. van der Meer (European Council for Nuclear Research, Geneva) Mar. 8, 1961. 11p.

A sub-program was written to facilitate calculations involved in evaluating focusing and bending properties of optical systems with quadrupole lenses and bending magnets. The "lens strength routine" computes the focusing strength needed to focus one point on another, and the tracing routine traces a particle trajectory through the system or any part of it. Program specifications are given, and an example is provided. (D.C.W.)

15318 (DESY-A-2.95) BESTIMMUNG DES POLPROFILS FÜR EINEN STARK FOKUSSIERENDEN C-MAGNETEN. (Design of the Pole Profile for a Strong Focusing C-Magnet). H. Hultschig (Deutsches Elektronen-Synchrotron, Hamburg). Dec. 1962. 13p.

Characteristics and design of a magnet to provide a maximum bending field of 10 kgauss with a superimposed quadrupole field with a gradient of 0.5 kgauss/cm are discussed. The magnet, to be used in observations close to the forward direction in production and scattering experiments, also provides for changes in the ratio of bending field and quadrupole field gradient and for inversion of the sign of the quadrupole focusing. (D.C.W.)

15319 (LNF-62/8) CANALE DI e^+ e^- DA 200-700 Mev OTTENIBILE CON IL SINCROTRONE. (Focusing of e^+ e^- at 200-700 Mev from a Synchrotron). Note No. 115. R. Evangelisti and G. Garolla (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). Feb. 13, 1962. 15p.

The criteria followed in the study of a magnetic focusing device adapted to the transport of a beam of 700-Mev electrons or positrons with a total trajectory length of 14 π are described. The approximate calculation of the conversion yield is given, and optical properties of the channel are determined. The electromagnetic characteristics of the lens and their aberrations are calculated. (J.S.R.)

15320 (LNF-62/67) TEORIA LINEARE DELLE MACCHINE ACCELERATRICI. PARTE I. EQUAZIONI LINEARI DEL MOTO E COEFFICIENTI DI SMORZAMENTO DELLE OSCILLAZIONI DI BETATRONE NEL CASO DI FOCHEGGIAMENTO DEBOLE. (Linear Theory of Accelerators. Part I. Linear Equations of the Motion and Attenuation Coefficient of Betatron Oscillations in the Case of Weak Focusing). Note No. 155. R. Balzano, G. Sacerdoti, and F. Uccelli (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). Aug. 3, 1962. 24p.

A study is made to compile and express in a unitary manner the linear theory (Gauss approximation) of the motion of relativistic particles in accelerators. The results that can be deduced from this theory are reported. The linearized equations of motion are derived. The matrix of vertical oscillations and the matrix of horizontal oscillations in the case of weak focusing are determined. (J.S.R.)

15321 (NIRL/M/21) TRAMP (TRACKING AND MATCHING PROGRAM). J. W. Gardner and D. Whiteside (Gt. Brit. National Inst. for Research in Nuclear Science, Harwell, Berks, England). July 1961. 21p.

A MERCURY program was developed for tracking and matching beam properties in high-energy beam design. It will track particle trajectories and beam ellipses in phase space through systems of quadrupoles, bending magnets, and velocity separators. It also contains a number of matching routines for adjusting quadrupole strengths or positions in order to obtain desired beam configurations. (auth)

15322 (ORNL-3365) NUCLEON-MESON CASCADE CALCULATIONS: TRANSVERSE SHIELDING FOR A 45-Gev ELECTRON ACCELERATOR. PART II. R. G. Alsmiller, Jr., F. S. Alsmiller, and J. E. Murphy (Oak Ridge National Lab., Tenn.). Feb. 28, 1963. Contract W-7405-eng-26. 44p.

In a previous report nucleon-meson cascade calculations were carried out for several cases of interest in the design of the transverse shield for the proposed 45-Bev linear electron accelerator at Stanford University. In this report results are given for several additional cases. Muon, neutron, pion, and proton intensities as function of energy and distance for varying angles are given. Corresponding doses are also included. (D.C.W.)

15323 (TID-15917) MAGNETIC SYSTEMS FOR LINEAR ACCELERATOR BEAM INJECTION. R. Belbeoch (Stanford Univ., Calif. Stanford Linear Accelerator Center). Jan. 1962. Contract AT(04-3)-363. 67p. (M-292)

Multiple-beam operation in a linear electron accelerator

is simplified if the electrons can be injected into the machine at some angle with respect to the accelerator axis. Characteristics of beams and magnet systems are given in matrix form, and several possible injection systems are analyzed. The best nonisochronous deflection system for injection seems to limit the injector angle to 45° to avoid a large debunching. The simplest system uses two bending and one quadrupole magnet. Injection at 90° implies the use of an isochronous system, the most attractive one being an off-center quadrupole system that requires design of a special quadrupole magnet. A system with three n-type magnets and two quadrupoles is also feasible and uses all the components in a classical way. (auth)

15324 (TID-16591) LINEAR ELECTRON ACCELERATOR STUDIES. Status Report, January 1–March 31, 1958. (Stanford Univ., Calif. Microwave Lab.). Apr. 1958. Contract AT(04-3)-21. 46p. (ML-504)

Continued successful operation of the double window and titanium pump assemblies on the Mark IV klystrons is reported. The needle point installation in the spark-gap switch assemblies has performed for eight months. The electroformed accelerator section at the Mark II also has operated well, and the accelerator has produced 44-Mev electrons with an electron current five times that of the former machine. The disk-loaded waveguide is being examined to determine if another configuration might have better properties. Some preliminary tests have been made, and a $2\pi/3$ mode with very thin disks has performed best. Grid-loaded structures are also being tested. New techniques for electroforming r-f couplers as part of an accelerator section, for joining five-foot electroformed accelerator sections with a gold-diffusion seal at the inner contact area and for joining waveguides have been developed. Beam loading studies using the r-f output pulse from an accelerator section have been made. A Cherenkov (water-cell) counter viewed by a 14-stage photo-multiplier hooked to an oscilloscope tube is being tested as a fast monitoring device. Zinc silicate and P-5 phosphor have been tested for visual observation of electron beam cross-sectional distribution; the P-5 phosphor proved more satisfactory. A permanent master oscillator consisting of a Sperry SAS-60A three-cavity amplifier klystron arranged to oscillate by means of a high-Q feed-back loop has been made operational. Tests on disk windows indicate that surface contamination of the window with metallic dust is not the sole cause of failure. A cone window in operation was found to glow, the color depending on the power level. A four cavity klystron tube was tested, but difficulties in tuning the third cavity made the results questionable. A technique for getting dose distributions for the electron beam using photographic films has been developed, and a small ionization chamber to measure dose distributions in water has been constructed. (D.C.W.)

15325 (TID-17766) YALE STUDY ON HIGH INTENSITY PROTON ACCELERATORS. A PROGRESS REPORT ON THE DESIGN OF A VERY HIGH INTENSITY LINEAR ACCELERATOR FOR PROTONS AT AN ENERGY OF 750 Mev. Internal Report Y-6. (Yale Univ., New Haven). Oct. 30, 1962. Contract AT(30-1)-2726. 121p.

The design of a very high intensity proton linear accelerator and its associated facilities, that together form a complete meson factory is discussed. The accelerator will deliver a 1 ma (average) primary proton beam at an energy that is variable from 200 to 750 Mev. Polarized protons can also be accelerated. The intense primary proton beam, that can be fully extracted from the accelerator, will produce intense well-defined secondary beams of pions, muons, neutrons, and neutrinos. These secondary beams will be separated from the proton beam and transported to various experimental areas where adequate shielding, both flexible and fixed, is provided. The sections of the report outline the justification, establish the feasibility, and estimate the cost of the installation. Tentative characteristics of the accelerator and the beams are presented, as are a number of studies that can be made with the assembly. 72 references. (auth)

15326 (TID-18052) ION BEAM CHARACTERISTICS OF THE OHIO STATE UNIVERSITY ELECTROSTATIC PARTICLE ACCELERATOR (thesis). Lowell Douglas Ferguson (Ohio State Univ., Columbus). 1960. Contract [AT(11-1)-147. 52p.

Expressions for the focusing properties of each segment of the accelerating tube and high voltage lens system of the Ohio State University electrostatic particle accelerator are derived separately. The system as a whole is then treated, and crossover characteristics of one lens are discussed. Operation of the energy analyzing magnet is examined, and an expression relating field strength to proton energy is presented. Calibration of the analyzer system using p-γ resonances of aluminum, fluorine, and lithium reveals an unexpected divergence of the magnet energy constant, perhaps due to frequency counter instability. (D.C.W.)

15327 (UCRL-10347) BEVATRON OPERATION AND DEVELOPMENT. XXXII. [Period Covered] November 1961 through January 1962. Kenneth C. Crebbin, William W. Salsig, William A. Wenzel, and Fred H. G. Lothrop (California. Univ., Berkeley. Lawrence Radiation Lab.). Dec. 14, 1962. Contract W-7405-eng-48. 19p.

The flywheels and shaft assemblies for the main generators were changed during the October shutdown. A vacuum extension tank was provided for external secondary beams. New induction electrodes and rapid beam ejector coils were installed. A trial poleface winding, and magnetic field and gradient probe were installed. A table summarizing the Bevatron experimental research program for 1961 is included. (auth)

15328 A SIMPLE METHOD FOR DETERMINING THE ZERO-PULSE OF A CYCLOTRON. M. Macovei, E. Ivanov, and N. Vîlcov. Acad. Rep. Populare Romine, Studii Cercetari Fiz., 13: 359-65(1962). (In Rumanian)

An experimental assembly which makes use of a single counter for recording the moment of the passage of a group of particles which generates a zero pulse, presents the advantage that the neutron flux is not limited by the dead-time of the first counter and of random coincidences and that the efficiency may be increased by 2 to 3 orders of magnitude. The method was used for the first time for electrostatic accelerators. A high-frequency electrostatic deflection system and diaphragms allowed the accelerated particles to pass toward the target only when the deflecting tension passed through a region of zero values. A cyclotron may be used as the source of pulsed particles. Fluctuations due to the accelerating tension, deflection plate tension, quadrupolar lens current, and deflecting magnet current affect the amplitude of the zero pulse. An Al target was used for bombardment by a proton beam. The delay caused by the time needed for the protons to reach the diaphragm was compensated for by about 300-nanosecond artifical delay in the path of the zero pulse. The resolution of the system was 5 nanoseconds. (TTT)

15329 ACCELERATION CHAMBER OF THE BETATRON OF THE INSTITUTE OF ATOMIC PHYSICS OF

BUCHAREST. E. Stoicovici, G. Baciu, M. Bădănoiu, N. Ciontea, and S. Haltrich (Inst. of Atomic Physics, Bucharest). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 13: 401-9(1962). (In Rumanian)

The technological process of the fabrication of the ceramic acceleration chamber for the betatron was described in detail in order to know the analysis of the superiority of the ceramic chambers over the glass chambers in the case of continuous pumping. The method of preparation of the chambers was examined with respect to their utilization in the betatron, such as the metallization of the internal surface of the torus and of the contacts at the center of mass of this metallization. The comparative data on the utilization of ceramic acceleration chambers, given by the betatron in operation, confirm their excellent behavior both with respect to the material and the fabrication process and to the preparation methods imposed by the rigorous operational conditions. (tr-auth)

15330 STUDY OF THE CHARACTERISTIC MAGNITUDES OF MAGNETIC FIELDS USED IN NUCLEAR APPARATUS WITH WEAK OR STRONG FOCUSING. C. C. Iliescu (Inst. of Atomic Physics, Bucharest). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 13: 463-71(1962). (In Rumanian)

The distribution of the magnetic field in the median plane of the air gap of electromagnets of nuclear apparatus with weak or strong focusing (particle accelerators, particle spectrometers, etc.) is taken as the starting point. This distribution is characterized by a given index of the constant field as a function of the radius. The general analytical relations, valid in the entire air gap, of the characteristic magnitudes of the magnetic field were deduced. The scalar magnetic potential, the vectorial magnetic potential, and the magnetic induction were determined. The relations established were utilized to study the movement of the charged particles in the nuclear apparatus mentioned and to determine the form of the pole pieces necessary to produce a given distribution of the magnetic field. (tr-auth)

15331 THE PROTON SYNCHROTRON OF CERN. Jean Gervaise (CERN, Geneva). Geometre, No. 11, 3-19(Nov. 1961).

The principles of a proton synchrotron are briefly reviewed, and the parameters of the CERN synchrotron are given. The problems presented by the design and construction of foundations for the machine are discussed. The instruments used in the measurements of length, angles, and levels to ensure the precision needed are described, and the results obtained are reported. (J.S.R.)

15332 FUTURE ACCELERATORS. John P. Blewett Intern. Sci. Tech., No. 14, 38-45(Feb. 1963).

An outline is given of the history and state of the art of particle accelerators. Methods for achieving higher energies are summarized, such as large-radium (e.g., 1.5 mile) conventional accelerators, colliding-beam accelerators with storage rings, and new acceleration concepts. (T.F.H.)

15333 THE OSCILLATOR FOR THE VARIABLE ENERGY CYCLOTRON. Izuo Hayashi (Tokyo Univ.). Nucl. Instr. Methods, 17: 261-72(Dec. 1962). (In English)

An oscillator for the cyclotron is developed by which the frequency can be changed over a wide range. The cavity of the oscillator is of a shielded Lecher-wire type. The shorting device, the plate loop, and the cathode loop are designed so as to enable a very easy change in the resonant frequency. The oscillator is used for a variable energy cyclotron. (auth)

15334 PROBLEMS OF THEORY AND MODELLING OF A RING-SHAPED PHASOTRON WITH SPIRAL FIELD DISTRIBUTION. Yu. N. Denisov, V. P. Dmitrievskii, V. P. Dzhelepov et al. (Joint Inst. of Nuclear Research, Dubna, USSR). Nucl. Instr. Methods, 21: 85-8(Jan. 1963). (In English)

Some problems related to the construction of the model of a ring-shaped phasotron with spiral magnetic field structure are considered. Basic parameters of the designed model are given and the sections of the magnetic system and the accelerator-injector of the model of the ring-shaped phasotron are described. (auth)

15335 THE PERFORMANCE AND CONDITIONING OF "INVERTED CONE" VAN DE GRAAFF ACCELERATING TUBES. S. E. Hunt, F. C. Cheetham, and W. W. Evans (Associated Electrical Industries, Aldermaston, Berks, Eng.). Nucl. Instr. Methods, 21: 101-5(Jan. 1963). (In English)

The performance of a porcelain walled accelerator tube having stainless steel electrodes in "inverted cone" formation was tested after almost four years' operation. The tube withstood a potential difference of 3.85 Mev compared to 3.7 Mev in its initial "commissioning" tests. Some retrograde current was measured in the later tests. A new tube with a similar electrode system, but employing glass insulating walls, has been operated up to 4.25 Mev without retrograde current. The influence of tube pressure on performance during the conditioning phase is discussed. (auth)

15336 THE C.E.R.N. ACCELERATOR: THE C.E.R.N. PROTON SYNCHROTRON. P. Germain. Onde Elec., 41: 972-5(Dec. 1961). (In French)

As an introduction to the study of the French bubble chambers at CERN, a general description is given of the CERN proton synchrotron. The purpose of this machine is to study the properties of basic particles. A brief survey is given of the modes of study. (J.S.R.)

15337 NUMERICAL DESIGN OF AXIALLY SYMMETRIC ELECTROSTATIC ION ACCELERATORS. Gerhard Rohringer (General Electric Co., Santa Barbara, Calif.). Rev. Sci. Instr., 34: 198-9(Feb. 1963).

A method is given for deriving the design of an axially symmetric electrostatic accelerator by numerical integrations alone. The approach is from a specification of the largest possible number of ion optical constants. The results of a sample calculation are given. (D.L.C.)

15338 THE PRODUCTION OF FAST PARTICLES BY ELECTROMAGNETIC WAVES. Winfried Otto Schumann (Technische Hochschule, Munich). Z. Angew Phys., 14: 760-3(Dec. 1962). (In German)

The production of fast particles by electromagnetic waves is discussed. For this it is necessary that an a-c field and a magnetic field spatially perpendicular to the electric field (the magnetic field is displaced about 90° in phase with respect to the electrical field) work on the particle. This following magnetic field was produced by the particle motion since this oscillates in the direction of the electric field cophasal with the field. An electrical wave overtaking the particle accelerates in this manner the particle in the beam direction. A relativistic estimation and an evaluation of the effect of damping and amplitude decrease of the waves during their broadening show that possibly large final energies can be attained, to be sure probably, only at very low frequencies that must lie approximately in the order or magnitude of the magnetic gyration frequencies. (tr-auth)

15339 RECENT ADVANCES IN DC METHODS OF PARTICLE ACCELERATION. E. Alfred Burrill (High Voltage Engineering Corp., Burlington, Mass.). Preprint Paper No. CP-63-391. New York, Institute of Electrical and Electronic Engineers, 1963. 20p. $1.00.

Paper from Winter General Meeting, New York, Jan.-Feb. 1963.

Four recent developments have broadened the scope of d-c particle accelerators: (1) tandem accelerators, (2) inclined-field tubes, (3) insulating-core transformers, and (4) high-intensity ion beams. These developments are discussed briefly with respect to typical acceleration systems now being utilized in research and industry. (D.L.C.)

15340 A LINEAR ELECTRON ACCELERATOR WITH $\beta_V = 1$ AND E_M = CONST. S. P. Lomnev and G. A. Tyagunov. p.21-38 of "Uskoriteli." Moscow, Gosatomizdat, 1962.

A numerical integration of equations of particle motion was performed for a great number of particles and different initial conditions in order to investigate the characteristics of a beam obtained with a linear electron accelerator with $\beta_V = 1$ and E_M = const. The results are represented in diagrams, which show that the particle capture is improved with a growth of injection energy and accelerating field strength. For each value of field strength amplitude there is a minimum value of injection energy, below which capture does not take place at all. Relationships described are: between E_M and the particle velocity at the entrance, between the phases of particle entrance into the beam and their exit from it for different E_M; the particle energy spectra at the exit; energy of particles at the exit as a function of their initial phase; and the focusing of particles by a longitudinal magnetic field. The formulas of interpolation which are presented, are useful, inasmuch as they provide the means for quickly estimating and explaining the qualitative dependences. (P.C.H.)

15341 L'ELETTROSINCROTRONE E I LABORATORI DI FRASCATI. (The Electron Synchrotron of the Frascati Laboratory). Giorgio Salvini. Bologna, Nicola Zanichelli, 1962. 388p.

Italy's 1100-Mev electron synchrotron is described in the wider setting of the Frascati laboratories. Theoretical calculations in the design are summarized, and decisions and problems met in design are discussed. Characteristics of the accelerator and its allied equipment are presented. (D.C.W.)

Plasma Physics and Thermonuclear Processes

15342 (AD-275762) SURVEY OF DIAGNOSTIC TECHNIQUES USED TO DETERMINE TEMPERATURE AND DENSITY IN PLASMAS. L. D. Dickson (Johns Hopkins Univ., Baltimore. Radiation Lab.). May 1962. Contract AF33(616)-6753. 86p. (AF-95; N62-12535)

A summary is given of the three major plasma diagnostic techniques (probes, microwaves, and spectroscopy) presently used to determine electron, ion, and gas temperature, and electron and ion density. A review of the theory for each technique is given and the relative advantages and disadvantages of each technique are discussed. A comparative examination is made to determine the areas of greatest applicability of each technique. 41 references. (auth)

15343 (AD-277562) ON ANODE GAS-SHEATH ELECTRICAL BREAKDOWN IN A HIGH-PRESSURE-ARC PLASMA GENERATOR. Research Report. John R. Wheaton and Robert C. Dean, Jr. (Dartmouth Coll., Hanover, N. H. Thayer School of Engineering). Oct. 1961. Contract AF33(657)-8179. 52p.

An experimental investigation into the mechanisms of electrical conduction across the low-temperature gas layer covering the cooled anode of a high-pressure nitrogen arc plasma generator is reported. Various flow regimes were identified; the turbulent mode was studied particularly. The cool wall gas sheath is shown to be bridged electrically by a moving concentrated arc. This arc behavior led to a cyclic variation of the potential difference between cathode and anode, but the arc current remained constant. Re-ignition of the arc after each cycle of travel down the nozzle-anode occurred by breakdown of the electrode gap in the neighborhood of the cathode. This breakdown occurred at abnormally low voltage differences; the evidence indicated that the breakdown is strongly affected by the aerodynamic characteristics of the flow around the cathode. Reduced data for arc velocity, cycle time, voltage fluctuations, and time-average arc characteristics are presented for nitrogen. (auth)

15344 (CLM-R-24) AN ANNOTATED BIBLIOGRAPHY OF ARTICLES ON PLASMA PHYSICS AND CONTROLLED THERMONUCLEAR RESEARCH BY U.K.A.E.A. STAFF, 1958 TO 1962. L. J. Anthony, comp. (United Kingdom Atomic Energy Authority. Research Group. Culham Lab., Culham, Abingdon, Berks, England). Jan. 1963. 61p.

Two hundred thirty-four references with abstracts are included to journal articles and conference papers on plasma physics and controlled thermonuclear research presented or published between January 1958 and December 1962. (D.C.W.)

15345 (LA-2802) A STUDY OF THE STABILITY OF A RELATIVISTIC PARTICLE BEAM PASSING THROUGH A PLASMA. R. C. Mjolsness (Los Alamos Scientific Lab., N. Mex. and Princeton Univ., N. J. Palmer Physical Lab.). Oct. 1962. Contract W-7405-eng-36. 233p.

The dispersion law is derived for small amplitude disturbances of the spatially non-uniform steady state configuration of a relativistic particle beam of finite cross section and infinite length passing through a low temperature dense plasma. First, a macroscopic analysis is given in which Maxwell's equations are supplemented by fluid equations for the beam and plasma effects are accounted for by means of a scalar conductivity. A more realistic treatment of the plasma is then obtained by introducing a variable tensor conductivity and appropriate boundary conditions, permitting the effects of Hall currents, density and temperature gradients, and metal walls to be assessed. Finally, the analysis is refined by treating the beam particles by means of the collisionless Boltzmann equation while maintaining the scalar conductivity description of the plasma. Use of the orbit integral technique for solving the Boltzmann equation permits the perturbed beam current to be expressed as an integral over the perturbed field variables, and the relativistic dynamics and the geometry of the configuration greatly increase the tractability of the expressions. Introduction of appropriate Hankel transforms of the field variables leads to an integral form for Maxwell's equations and to the expression of the stability problem as a set of three linear, coupled integral equations. A formal solution of these equations is given, and the dispersion relation is seen to appear as a solvability condition for the equations. Asymptotic evaluations of the formal expressions are given for the case of low frequency, long wavelength disturbances and high frequency, highly localized disturbances. 55 references. (auth)

15346 (LADC-5340) WAKE OF A LARGE SPHERE MOVING SUPERSONICALLY THROUGH A PLASMA. Walter F. Huebner (Los Alamos Scientific Lab., N. Mex.) and J. R. Herring (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.). [1961]. Contract W-7405-eng-36. 36p.

A linearized electrofluid-dynamic treatment is applied to the calculation of the structure of the wake produced by a large sphere moving supersonically through a plasma. The computations involve constants believed to be appropriate for the interaction of the solar wind with the moon, but apply also under certain conditions at a point near apogee for a large satellite in a highly elliptic orbit. Density fluctuations up to 30% are obtained some distance inside the wake. The equations are more suitable for the examination of the wake produced by a satellite moving through the ionosphere than for the investigation of the wake produced by the solar wind interacting with the moon. (auth)

15347 (MATT-135) FURTHER STUDIES OF PLASMA MOTION IN A CURVED MAGNETIC FIELD. H. P. Eubank and T. D. Wilkerson (Princeton Univ., N. J. Plasma Physics Lab.). July 1962. Contract AT(30-1)-1238. 21p.

Additional measurements of the transmission of a burst of plasma through a 90° bend in magnetic field include a mass and energy analysis of the incident and transmitted plasma. Under certain conditions of input density and bend magnetic field, tenfold reductions in plasma contaminants (atomic mass > 3) may be realized. Some further results on the source of neutralization of the polarization field are presented and discussed. (auth)

15348 (MATT-152) SOME INVESTIGATIONS OF PLASMA INSTABILITIES IN ONE-DIMENSIONAL PLASMAS. John Dawson and Craig Smith (Princeton Univ., N. J. Plasma Physics Lab.). Nov. 1962. Contract AT(30-1)-1238. 45p.

A review of work on plasma models primarily involving unstable situations is presented. Double stream instabilities are observed in which two cold streams of electrons pass through each other and through a fixed neutralizing background. Current instabilities are observed in which an electron current is passed through two species of plasma. Violent instabilities were observed in the double-stream and high-current instabilities which lead to rapid breaking in the double-stream case and to rapid plasma heating in the high current case. The plasma is observed to stabilize itself in a low-current situation. (J.R.D.)

15349 (NYO-9754) GRAVITATIONAL INSTABILITY AND ONE-COMPONENT PLASMA OSCILLATIONS. Richard L. Liboff (New York Univ., New York. Courant Inst. of Mathematical Sciences). Nov. 30, 1962. Contract AT(30-1)-1480. 15p. (MF-33)

A kinetic study is made of a system of neutral particles which interact under gravitational forces. The Jeans instability is recaptured in the limit of long wavelengths where the growth rate assumes a characteristic maximum value. As the wavelength diminishes to a certain critical distance, the instability vanishes. This distance is consistent with thermal-gravitational estimates for the diameter of a star. Plasma oscillations are found in the central region of a one-component charged gas cloud. (auth)

15350 (RM-3440-PR) INCOHERENT SCATTERING OF RADIO WAVES BY A PLASMA. D. F. DuBois and V. Gilinsky (RAND Corp., Santa Monica, Calif.). Jan. 1963. Contract AF49(638)-700. 23p. (AD-296931)

The incoherent scattering of radio waves from a hot plasma is computed using the diagrammatic techniques of quantum electrodynamics. This method simplifies previously obtained results and permits extensions to include the effects of close collisions. (auth)

15351 (TID-16057) STUDIES OF PLASMA OSCILLATIONS. Quarterly Status Report No. 8, September 1–November 30, 1961. (Stanford Univ., Calif. Microwave Lab.). May 1962. Contract AT(04-3)-326. 11p. (ML-919)

The principle of measuring the number density of plasma by its proportionality to plasma frequency is explained. Two methods of calibration are described. One uses the output signal of the detector plotted versus the tubes d-c current and yields the average fluctuation in density as a proportionality involving the resonant frequencies associated with the d-c currents. The other method involves placing a low frequency a-c signal in series with the d-c power supply, producing a small a-c current in the tube and changing the plasma density. By proper calibration the ratio of change in number density (Δn) to d-c number density (n_0) is derived as ratios of a-c number density or current to d-c number density or current. Measurements by the second method were used to plot $\Delta n/n_0$ along a mercury plasma column. Near the cathode variations in number density greater than 25% were found. Measurements of light output as a function of distance along the tube showed the nature of light output to be similar to the a-c density. Light output was also observed to be a maximum when a-c voltage was a minimum, indicating a possible 180° change in voltage phase in this region. (D.C.W.)

15352 (TID-17791) SOME MEASUREMENTS OF STEADY AND FLUCTUATING PLASMA NUMBER DENSITIES BY A MICROWAVE METHOD. F. W. Crawford, G. S. Kino, S. A. Self, and J. Spalter (Stanford Univ., Calif. Microwave Lab.). Oct. 1962. Contract AT(04-3)-326. 55p. (ML-961)

Measurements of d-c and a-c components of number density along the positive columns of hot-cathode, mercury-vapor discharges, at a presusre of about 1 μ Hg, were made by a microwave method. The technique is based on a dipole resonance, occurring below the electron plasma frequency, which is excited by an r-f signal transmitted along a strip-line enclosing the plasma column. By working on the side of the resonance curve, a fluctuating output signal is obtained corresponding to the density fluctuations. The simple theory of the resonance has been extended to take account of strip-line size, of the glass surrounding the column, and of a radial variation in number density. The method is considerably more sensitive than cavity perturbation techniques, and the results compare reasonably well with number density measurements made by other methods. It is found that the frequency spectrum of fluctuations is similar to those of the potential and light output fluctuations; that there are similarities in the distribution along the column of the amplitudes of these quantities; and that for injected a-c signals, the phase and amplitude variation of the number density are as predicted theoretically. (auth)

15353 (TID-18005) SOME EXPERIMENTAL EVIDENCE FOR THE PREVENTION OF RAPID LINE ESCAPE OF PLASMA IN A MAGNETIC CUSP FIELD. George J. Yevick and Robin Harvey (Stevens Inst. of Tech., Hoboken, N. J.). [nd]. Contract [AT(30-1)-2250]. 10p.

Plasma containment in a cusped field of peak value 30 kOe is described. Methods for reducing line escape of plasma in the configuration are discussed. With 24-μf capacitor banks and 30 kv on the banks, an energy of 10^4 j

is obtained, of which 10% can be coupled into the field coil. (T.F.H.)

15354 (TID-18059) COLLIDING BEAMS TRAVERSING A FINITE PLASMA. Technical Report No. 9. B. N. A. Lamborn (Florida. Univ., Gainesville). Jan. 25, 1963. Contract AT(40-1)-2783. 27p.

The interaction of a set of colliding beams and a background plasma is discussed in the limit where the time necessary for a beam particle to traverse the plasma is short. In this limit the collective modes of oscillation of the beams are not necessarily in equilibrium with the plasma modes. Instead the beams may act as a constant forcing term on the equations of motion for the plasma modes. Two types of unstable oscillations exist for plasma modes that are harmonic to the beam mode. The first type, due to coupling of growing beam waves arising from the two-stream instability of the beams, gives an exponential increase of the harmonic plasma modes. The second type occurs when the frequency of the beam oscillations match the background plasma frequency and leads to a linear growth of the plasma waves. If the ion motions and thermal velocities may be neglected, then this effect gives standing electron waves under the condition $\omega/kv = 1 \pm \sqrt{N_b/N_p}$, where N_b is the beam density, N_p is the plasma density, v the beam velocity, and ω is approximately the plasma electron frequency. (auth)

15355 (AERE-Trans-921) DIFFUSION OF THE BEAM IN A PLASMA. T. Homma. Translated by L. Allen (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Kakuyugo-Kenkyu, 6: 442-56 (1961). 17p.

When a beam enters a plasma in steady equilibrium, the particles receive a perpendicular velocity component due to collisions with plasma particles. For high incident energies, this vertical component is large compared to the forward retardation. Accordingly the diffusion of a beam in a magnetic field can be treated using Brownian movement theory and considering only the perpendicular component and the space displacement that results from it. The probability distributions and diffusion in velocity are derived for the case of a magnetic field and the case of no field. The magnetic field is noted to have no effect on the diffusion in velocity space. A similar calculation of diffusion in position space with no magnetic field is made, as well as the distribution of the rotation center. Average values of the perpendicular velocity and the displacement of the rotation center are also examined. (D.C.W.)

15356 (AERE-Trans-924) TURBULENT DIFFUSION IN A PLASMA COLUMN IN A STRONG MAGNETIC FIELD. AN EXAMINATION OF KADOMTSEV'S THEORY. Masatomo Sato. Translated by D. Jackson (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Kakuyugo-Kenkyu, 8: 563-80(1962). 22p.

The turbulence problem in plasmas containing a field > the critical field is examined in terms of Kadomtsev's turbulent convection theory. An appropriate method is used for obtaining the imaginary part of the frequency by the linearized theory of instabilities. Results obtained are then used to examine turbulent diffusion, and it is noted that the diffusion coefficient has a 1/B dependence for $B >> B_k$, where B_k represents the magnetic field under specified turbulence conditions. A dependence of the electric field on the magnetic field and a B^{-1} dependence of the diffusion to the wall are also indicated. An inconclusive attempt is made to relate results obtained with experimental results. 20 references. (D.C.W.)

15357 ELECTRICAL DISCHARGE ACROSS A SUPERSONIC JET OF PLASMA IN TRANSVERSE MAGNETIC FIELD. Serge T. Demetriades and Peter D. Lenn (Northrop Corp., Hawthorne, Calif.). AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 234-6(Jan. 1963).

Observations were made of the discharge between two electrodes placed across a supersonic stream of ionized gas. A magnetic field transverse to both the flow direction and the electrode axes was applied. Visual observations of the behavior of the discharge with and without magnetic fields are described, and qualitative explanations of the observed phenomena are proposed. (auth)

15358 COMMENT ON "USE OF BALLISTIC PENDULUMS WITH PULSED PLASMA ACCELERATORS." William J. Guman (Republic Aviation Corp., Farmingdale, N. Y.). AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 246(Jan. 1963).

The inaccuracy of impulse measurement in pulsed plasma accelerators by ballistic pendulums is discussed. Direct-measuring thrust stands instead of ballistic pendulums are being used in the electric propulsion field. (D.L.C.)

15359 EQUILIBRIUM OF A PLASMA CONTAINED IN A TORUS WITH ELLIPTICAL CROSS SECTION. Giorgio M. Ferrero. Atti Accad. Sci. Torino. I. Classe Sci. Fis., Mat. Nat., 96: 918-26(1961-62). (In Spanish)

The problem of plasma equilibrium is reduced to the determination of the magnetic field and the pressure, which can be expressed by means of a convenient function, the field function. A particular case that can be completely resolved and which allows the stabilization of the form (elliptical) of the torus cross section is then considered. (tr-auth)

15360 HEATING AND THERMAL EFFECTS IN THE PROPAGATION OF RIGHT-ANGLE CIRCULARLY POLARIZED WAVES. CLASSIFICATION OF THE EFFECTS OBSERVED. Térenzio Consoli, Georges Ichtchenko, and Micheline Weill. Compt. Rend., 256: 626-9(Jan. 14, 1963). (In French)

The experimental study of the heating of a dense plasma by right-angle circularly polarized waves should permit, in the preliminary step on less dense plasmas, the qualitative verification of some of the properties of this type of privileged propagation, in particular, the thermal effects predicted by J. E. Drummond. (tr-auth)

15361 SEQUENCE TIMING EQUIPMENT OF THE STABILIZED TOROIDAL PINCH DEVICE. Shuichiro Kawamata and Masaru Sugiura. Denki Shikensho Iho, 26: 691-8 (Sept. 1962). (In Japanese)

Sequence timing controls in a stabilized toroidal pinch device are described. The controls operate on the following: opening of the protective disconnecting switches; charging of the condenser banks; application of the toroidal stabilizing magnetic field of plasma and the r-f field for preionization; discharge of the main condenser banks and ceasing of the r-f field; application of the parallel opposite stabilizing magnetic field; crowbar operation with ignitrons; and close of the protective disconnecting switches. The control equipment is constructed by trial and error. The equipment is constituted of two panels; one has magnetic relay circuits and the other has electronic circuits. (auth)

15362 RESPONSE FUNCTION OF A DEGENERATE ELECTRON GAS. P. Misra and D. Misra (Ravenshaw Coll., Cuttack, India). Indian J. Phys., 36: 549-56(Nov. 1962).

The electrical behavior of a homogeneous electron gas is described by the "response function" $\tilde{K}(k\omega)$, defined by a relation that in space-time configuration becomes a nonlocal and acausal relation. This function is analogous to the inverse of "impedance" in electric circuits and determines how an electrical disturbance propagates in the electron gas and under what circumstances the disturbance becomes oscillatory. The expression for the energy loss and scattering of charged particles involves this response function. For these reasons the function is an important parameter for an electron gas. This function is evaluated for an electron gas at absolute zero temperature and at temperatures in the neighborhood of absolute zero, by using the Boltzmann-Vlasov equations and Fermi-Dirac distribution law of electron energies. The causality condition is invoked to make the current-electric field relation causal. Conditions under which the electrical disturbance becomes oscillatory are discussed. It is found that these conditions are the dispersion formulae for the plasma oscillations of the electron gas. (auth)

15363 ELECTRICAL BREAKDOWN IN HIGH-TEMPERATURE GASES. D. W. George and H. K. Messerle (Univ. of Sydney). Nature, 197: 584-5(Feb. 9, 1963).

Results are reported from measurements of electrical breakdown in high-temperature argon and helium between concentric graphite electrodes. Measurements were made with an optical pyrometer through a small hole in the outer electrode. Current-voltage characteristics were obtained with an oscilloscope. (C.H.)

15364 MAGNETIC FIELD AND TEMPERATURE VARIATIONS IN A TOROIDAL PINCH DISCHARGE. S. Svennerstedt, S. Berglund, and S. Westerlund (Univ. of Uppsala). Nucl. Instr. Methods, 17: 231-47(Dec. 1962). (In English)

In experiments on toroidal pinch discharges of moderate energy the stability dependence on the applied voltage, longitudinal magnetic field, and initial gas pressure is studied. A Bessel-function model based on the assumption of a force-free configuration is found to agree with the experimentally determined field distributions. Electron temperature determinations are made from measurements of the hydrogen continuum and the intensity ratio between H_β and the continuum. Electron density and ion temperature are obtained from time resolved profile measurements on H_β and impurity lines. The conventional pinch configuration with an internal longitudinal field is supplemented by an outer reversed field. The application of this field gives a larger compression of the plasma and an increase of the electron temperature by a factor of two or three, but the intermixing of fields is followed by a rapid outward drift of the current channel and a decrease of both temperature and plasma current. (auth)

15365 THE STRUCTURE OF THE COLLISIONLESS PLASMA-SHEATH TRANSITION. A. Caruso and A. Cavaliere (CNEN, Frascati, Italy). Nuovo Cimento (10), 26: 1389-1404(Dec. 16, 1962). (In English)

A discussion is given of the transition from the region where the ionization is dominant to the region where the space charge is important, for a collisionless model of a low-pressure arc discharge. As the relevant Poisson equation contains a very small parameter which multiplies the second order derivative, a singular perturbation formalism leads to an unambiguous definition of the plasma and the sheath regions, and to a precise reformulation of the Bohm criterion. The same formalism allows explicit calculations, on the basis of particular models, of the potential within the sheath and the plasma, and of the ion current to the wall. (auth)

15366 PROPERTIES OF A DECAYING PLASMA. D. R. Bates and A. E. Kingston (Queen's Univ., Belfast and Univ. of Liverpool). Planetary Space Sci., 11: 1-22(Jan. 1963).

Attention is confined to plasmas which consist of electrons, protons, and hydrogen atoms only and which are optically thin either, case A, throughout the spectrum or, case B, except towards Lyman line radiation (which is completely absorbed). Tables are presented from which the number densities of excited atoms and the net power radiated may readily be obtained. Possible errors due to elastic collisions not being taken properly into account are discussed. (auth)

15367 THE BEHAVIOR OF A MAGNETOHYDRODYNAMIC BOUNDARY LAYER AT LOW MAGNETIC REYNOLDS NUMBER IN AN ANISOTROPICALLY CONDUCTING MEDIUM. G. A. Lyubimov. Priklad. Mat. i Mekhan., 26: 1077-86(Nov.-Dec. 1962). (In Russian)

The magnetohydrodynamic boundary layer was investigated in a region that contained the dielectric for small values of the parameter $mL = \sigma H^2 L/\rho c^2 U(1 + \omega^2\tau^2)$. The magnetic field is perpendicular to the region. In contradistinction to the case of a boundary layer in a homogeneously conducting medium, the current in the layer in an inhomogeneously conducting medium does not appear in a plane. Consequently, the problem requires the solution of two, instead of one, ordinary differential equations. Some results are given for the case of a semi-infinite plane. (TTT)

15368 PROPERTIES OF PLANE AND AXIALLY SYMMETRIC STATIONARY CURRENTS IN MAGNETOHYDRODYNAMICS. Yu. P. Ladikov. Priklad. Mat. i Mekhan., 26: 1087-91(Nov.-Dec. 1962). (In Russian)

Stationary currents of an infinitely conducting gas were studied. The conditions that $\nabla\vec{\rho}\ v = 0$ and $\nabla H = 0$ allowed the derivation of a current function $\phi(x,y)$ and a magnetic force function $\chi(x,y)$. The equation of motion of the gas were then given in terms of ϕ and χ. Under some conditions the equations have integrals, one of which is analogous to Bernouilli's integral, while the other has no analog in ordinary gas dynamics. In the case where the magnetic field is perpendicular to the velocity the solution of the problem led to a linear equation in partial derivatives of the second order. Several solutions for plane and axially symmetric currents were investigated. (TTT)

15369 ON THE DERIVATION OF EQUATIONS IN ANISOTROPIC MAGNETOHYDRODYNAMICS. V. B. Baranov. Priklad. Mat. i Mekhan., 26: 1092-3(Nov.-Dec. 1962). (In Russian)

After some errors in previous papers are pointed out, the components of the viscosity tensor and the heat flow vector for a fully ionized gas consisting of electrons and singly charged ions are given. The one-fluid approximation was used, and an equation for the components of the viscosity tensor and heat flow vector is presented. In the absence of currents and magnetic fields this equation becomes just the energy equation of ordinary hydrodynamics. Parts of it can be associated with well-known effects; e.g., the Thompson effect, the LeDue-Righi effect, and the Ettingshausen effect. The latter two are connected with the Larmov precession of electrons in a magnetic field. (TTT)

15370 PLASMA DISCHARGE AT LOW FILLING PRESSURE IN THERMAL EQUILIBRIUM. Herbert Schirmer (Osram-Studiengesellschaft, Berlin). Z. Angew. Phys., 14: 665-8(Nov. 1962). (In German)

With the help of a formal expression for the difference between electron temperature T_e and gas temperature T_g

in a plasma discharge, it was shown that wall-stabilized long arc discharges at low filling pressure can show high-pressure character when they are operated with sufficiently high current density. The result of numerical calculations on xenon high pressure long-arch discharges at high and low filling pressure was given. (tr-auth)

15371 UPRAVLYAEMYE RAZRYADNIKI DLYA KOMMUTATSII BOLISHIKH IMPUL'SIYKH TOKOV V VYSOKOVOL'TNYKH USTANOVKAKH. SBORNIK REFERATOV 1945–1961. (Control of a Discharge Device for High-Pulse Current Commutation in High-Voltage Installations. Compilation of Abstracts 1945–1961). S. A. Smirnov and F. F. Tereschenko. Moscow, Gosatomizdat, 1962. 86p.

A collection of abstracts and patents is included as references on the construction, electric characteristics, and applications of discharge devices for high-current, high-voltage installations. The material is arranged in chronological order with an assigned number. An author index is included. (R.V.J.)

15372 CONTROLLED FUSION TODAY. Arthur H. Snell (Oak Ridge National Lab., Tenn.). Preprint Paper No. CP-63-559. New York, Institute of Electrical and Electronic Engineers, 1963. 21p. $1.00.

Paper from Winter General Meeting, New York, Jan.-Feb. 1963.

A personal survey is presented of the present state of research on the problems of heating and containment in controlled thermonuclear reactions. The instabilities and various possible ways of controlling them are discussed. It is concluded that high-energy injection is the most promising approach to the heating problem and that the containment problem is less serious than in the past. (D.L.C.)

15373 WAVES IN ANISOTROPIC PLASMA. William P. Allis, Solomon J. Buchsbaum, and Abraham Bers. Cambridge, Mass., Massachusetts Institute of Technology Press, 1963. 288p.

A treatment of the theory of free and guided wave propagation in plasmas in a magnetic field is presented. The magnetoionic, acoustic, and magnetohydrodynamic regimes are treated in the theory of an unbounded plasma. Conservation principles of energy and power flow are considered with respect to guided waves in bounded plasmas. (D.L.C.)

Shielding

15374 (AD-278119) GAMMA DOSE RATES AND ENERGY SPECTRA IN A 3-FOOT SQUARE DUCT. Technical Note No. 443. J. M. Chapman (Naval Civil Engineering Lab., Port Hueneme, Calif.). June 29, 1962. 38p.

Dosimeter measurements and gamma-ray spectra were taken in a 3-foot square concrete duct. The spectra are used to determine the dose rate contributions from the individual scattering areas and to determine the percentage of these dose rate contributions resulting from multiple scattering in the first leg. Dose rates are compared with calculated values, and it is found that calculated values are always low. This discrepancy is attributed to the effects of multiple scattering. (auth)

15375 (LAMS-2800) FLEXIBLE NEUTRON SHIELDING SYSTEMS BASED ON VINYL PLASTISOLS. James S. Church and John K. Donahoe (Los Alamos Scientific Lab., N. Mex.). Sept. 5, 1962. Contract W-7405-eng-36. 30p.

A method was developed for fabrication of cast, flexible neutron shielding. The process is based on a filled polyvinyl chloride (PVC) plastisol system which can be fabricated by either slush casting or low pressure compression molding. Filler concentrations of 50 wt % boron or boron carbide are readily attained with retention of a fair degree of flexibility. (auth)

15376 (N62-11035) EVALUATION OF VARIOUS APPROACHES TO THE PROBLEM OF SHIELDING SPACE VEHICLES FROM IONIZING RADIATION. Norris F. Dow, S. P. Shen, and J. F. Heyda (General Electric Co. Missile and Space Vehicle Dept., Philadelphia). Mar. 1962. Contract NASr-34. 130p.

A general method of evaluating the efficiency of space vehicle shielding is developed and used to compare various active and passive systems for protection against ionizing radiation. Available permanent magnets are found useless for active shielding, and combined active-passive systems in general are determined to be inefficient. On the other hand, evaluations show that active electrostatic shielding may have possibilities for weight savings if electrical conditions (presently unknown) are favorable therefor in space. Further, a positive potential improvement is calculated for an active shielding system which utilizes superconducting Nb_3Sn to provide a confined magnetic flux to deflect incident charged particles; this potential points toward substantial reductions in shield weight for the protection of large vehicles from highly energetic particles. Recommendations are made for further research, particularly for flight experiments to measure directionality of solar flare protons. (auth)

15377 (ORNL-3406) NUCLEON-MESON CASCADE CALCULATIONS: SHIELDING AGAINST AN 800-Mev PROTON BEAM. R. G. Alsmiller, Jr. and J. E. Murphy (Oak Ridge National Lab., Tenn.). Feb. 21, 1963. Contract W-7405-eng-26. 26p.

Nucleon-meson cascade calculations were carried out and the dose as a function of depth was obtained for an 800-Mev proton beam incident on a shield. The physical properties used for the shielding medium are only a rough approximation to the properties of any particular medium. Muon, neutron, pion, and proton dose rates and fluxes are listed. (auth)

15378 SHIELDING OF THE RADIATION OF A CYLINDRICAL SELF-ABSORBING SOURCE IN THE AXIS DIRECTION. F. W. Krueger and E. Atze (VEB EPkA, Berlin). Kernenergie, 5: 787-90(Oct.-Nov. 1962). (In German)

A relation was derived for the radiation flux that is produced by a shielded self-absorbing cylindrical source in the axial direction. The integral occurring in the relationship is calculated numerically, and the results are tabulated. (tr-auth)

15379 EFFECT OF THE SCATTERING OF GAMMA AND X-RAYS ON THE DIMENSIONING OF SHIELDING. Aleksa Steiner. Tehnika (Belgrade), No. 11, 2129-36(1962).

The case of narrow monoenergetic gamma and x-ray beams is discussed, including the measurement of the total attenuation of intensity on passing across matter, the cross-section, the linear total attenuation factor, the calculation of total attenuation, the mass factor of total attenuation, and the shares of the effect of individual reactions (Compton effect, pair formation, Rayleigh scattering, nuclear photo-effect, and bremsstrahlung) on the value of total attenuation. Discussion on the broad monoenergetic beams considers the build-up factor in general, and for the intensity, dose and energy, and finally with differences in the definitions of the factor, and some of its properties. (P.C.H.)

Theoretical Physics

15380 (UCRL-6981-T) A NOTE ON THE MAXIMUM BOUND PRINCIPAL QUANTUM NUMBER. Carl A. Rouse

(California. Univ., Livermore. Lawrence Radiation Lab.). July 1962. Contract [W-7405-eng-48]. 12p.

A semi-classical formulation of the problem of the maximum bond principal quantum number is presented in terms of the radial distribution function for the free particles of an ion atmosphere. Using the charge distribution for a classical Debye atmosphere, the maximum bound principal quantum number is essentially the same for the excited electron moving in the ion atmosphere or in a constant central potential due to this same ion atmosphere. (auth)

15381 NOTE ON THE CANONICAL FORMALISM OF THE THEORY OF RESTRICTED FIELDS. J. Katz. Bull. Classe Sci., Acad. Roy. Belg., (5), 47: 1015-34(1961). (In French)

The generalized Dirac canonical formalism is applied in a systematic manner to the electromagnetic field and to the linearized gravitation field. Thus the orthogonal decompositions come directly from the canonical transformations in which the restrictions become moments. (tr-auth)

15382 RESOLUTION OF THE BOLTZMANN EQUATION. Herbert Budd (Laboratoire de Physique, E.N.S., Paris). Compt. Rend., 256: 615-18(Jan. 14, 1963). (In French)

The exact solution of the Boltzmann equation in the relaxation time approximation is given, and the validity of this equation is discussed. It is shown how the resolution of the Boltzmann equation in the general case is made by an iterative method beginning with the solution of the Boltzmann equation in the relaxation time approximation. A perturbation method of the Boltzmann equation is given. (tr-auth)

15383 REPRESENTATION OF A GROUP IN RELATIVISTIC QUANTUM MECHANICS. M. C. Goodall (Massachusetts Inst. of Tech., Cambridge). Nature, 197: 585-6(Feb. 9, 1963).

It is postulated that the underlying group of relativistic quantum theory is not the Lorentz group but rather one for which non-unitary representations have a special significance. Preliminary details are presented to substantiate this idea. (C.H.)

REACTOR TECHNOLOGY

General and Miscellaneous

Refer also to abstracts 14114, 14122, 14415, 14457, 14597, 14602, 14711, 14732, 14733, 14749, 14752, and 14753.

15384 (ANL-6661) CALCULATIONS FOR ZPR-VII UNIFORM LATTICE CRITICAL EXPERIMENTS WITH THORIA–URANIA FUEL IN HEAVY WATER. E. M. Pennington (Argonne National Lab., Ill.). Dec. 1962. Contract W-31-109-eng-38. 56p.

Calculations are reported relating to the uniform lattice critical experiments performed in the ZPR-VII critical assembly with both THUD and Babcock and Wilcox thoria-urania fuel and heavy water as moderator. Constants appearing in the criticality equation and material bucklings are computed for lattice pitches used. Reflector savings are calculated and used in conjunction with experimental critical dimensions to calculate geometric bucklings. Analyses are carried out for various experiments, such as measurements of U^{235} and Th–Cd ratios, water worth, and fuel-substitution experiments. Theoretical and experimental values are compared whenever possible. (auth)

15385 (ANL-6683) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, JANUARY 1963. (Argonne National Lab., Ill.). Feb. 15, 1963. Contract W-31-109-eng-38. 59p.

Research and development activities are reported on Borax V, ZPR-III, -VI, and -IX, EBR-I, EBR-II, and FARET. Reactor technology investigations are reported in reactor physics, reactor fuel development, viewing systems, heat engineering, and chemical separations. Research on advanced systems is reported on reactors and undersea nuclear power applications. Nuclear safety development in thermal and fast reactors is also reported. (J.R.D.)

15386 (BMI-RI-5886) SIMULATED NUCLEAR REACTOR SYSTEM FOR HIGH-TEMPERATURE PROCESS HEAT: 1,000-HOUR DEMONSTRATION RUN AT 2,500°F. Neil H. Coates, J. P. McGee, and G. E. Fasching (Bureau of Mines. Morgantown Coal Research Center, W. Va.). Mar. 1961. 16p.

In a joint program for using nuclear energy to supply process heat, a pilot-scale simulated nuclear reactor system was constructed. Although workable components were developed, the simulated nuclear reactor could not be operated continuously at its design conditions of 2,500°F and 250 psig because the refractory materials used for insulation deteriorated. Replacement of these materials with porous C permitted sustained operation at design conditions, and a 1,000-hr demonstration run was completed. No serious operating difficulties developed during the test. Leakage of He after 1,000 hr was only 3 to 4 std cfh. Inspection after the run revealed no damage to any of the components. Including earlier runs during previous research the system was operated about 4,000 hr, of which 1,120 hr were at 2,500°F or higher. The He-recycle compressor performed satisfactorily with no maintenance whatever for 2,445 hr, with about 2,000 hr at 900 to 1,000°F. (auth)

15387 (BMI-X-10032) A STUDY OF ROTARY SHAFT-SEALING CONCEPTS FOR PRESSURIZED-WATER REACTOR APPLICATION. Quarterly Progress Report for October–December, 1962. C. M. Allen and John W. Kissel (Battelle Memorial Inst., Columbus, Ohio). Jan. 1, 1963. Work performed under United States–Euratom Joint Research and Development Program. Contract W-7405-eng-92. 7p. (EURAEC-547)

The operation and limitations of various concepts of rotary shaft sealing for pressurized-water reactor applications are being studied. The range of operating conditions, which are of interest for application to primary-coolant loops of water-cooled nuclear reactors designed to produce 250 megawatts of electrical power were previously established. The behavior of rotary face seals is being studied by means of an instrumented transparent model. The use of a transparent rotor provides an opportunity for direct observation of the fluid in the seal gap during operation. The seal apparatus was designed, constructed, and commissioned. Initial operation has not disclosed any serious problems, though a revised water circulation system, which substitutes a double loop for the former single-loop system, is being installed. Instrumentation for determining the dynamic seal gap width has been evaluated and seems satisfactory for the purpose intended. A packed-gland seal facility was designed and is being constructed. The facility will be capable of handling both conventional and inverted packing-seal configurations. Instrumentation includes means for measurement of packing temperature and frictional torque and optical systems for direct observation of the packing rubbing interface. Analytical research was initiated towards developing seal-packing configurations which will provide greatly improved cooling and lubrication of the seal interface. (auth)

15388 (CEND-167) DESCRIPTION AND ANALYSIS OF NUSU CRITICAL EXPERIMENTS WITH ANNULAR MULTITUBE SUPERHEATER FUEL ELEMENTS. P. G. Klann, C. O. Dechand, M. F. Gormley, and J. S. Crudele (Combustion Engineering, Inc., Windsor, Conn.). Aug. 1962. Contract AT(11-1)-795. 102p.

In previous phases of the Nuclear Superheat Program (NUSU), measurements were made with critical arrays of rod type and of double annular type fuel elements in both clean arrays and in geometries simulating superheating core designs. The assemblies were light water moderated and the steam channels contained either water (flooded) or air (voided). Experiments and analysis were continued on critical cores built of annular multitube fuel elements spaced on a triangular lattice, with two lattice spacings. These fuel elements consist of two concentric stainless steel tubes in which the annular region between the tubes is filled with 2.55 wt % enriched UO_2 vibratory compacted to 84% theoretical density. The fused oxide was re-claimed from the double annular elements and was re-used without any re-processing. The fuel annulus is penetrated by the steam superheater channels which are 15 full length stainless steel tubes arranged in a circular pattern. In the operating reactor, water is evaporated on the inner and outer clad surfaces of the fuel element. The annular multitube fuel element design is considered superior to the double annular fuel element from the standpoint of performance, reliability, and cost of fabrication and was therefore suggested as an alternate fuel element for the NUSU Reference Design. Data were obtained for checking the validity of the physics analysis methods which were developed for the

superheat fuel elements previously investigated, and also to guide any further development of analysis techniques. Comparisons were made between calculation and measurement of criticality and power distribution, and also of the lattice parameters connected with the resonance escape probability and thermal utilization. Measurements were made at water-to-oxide volume ratios of 2.210, 1.485, and 1.300, which correspond to the hydrogen-to-U^{235} atomic ratios encountered in operating cores. Agreement on reactivity to within one percent was obtained between calculation and measurement for clean critical configurations at these water-to-oxide volume ratios, with the steam tubes alternately flooded and voided, and for critical configurations containing heterogeneities such as water gaps formed by removing fuel elements or by the addition of poison elements. Reasonable agreement between measured and calculated power distributions around centrally located core heterogeneities was also obtained with an over-estimation in power of about 18% noted for fuel elements located at the vertices of rather thick, 2.86 in., Y-shaped water gaps at the center of the core. The tendency to over-estimate the power near water gaps was previously noted in the analysis of double annular cores. It was shown that the predicted power in a fuel element is insensitive to the thermal cross section scheme. Also, it was shown that the over-estimate is not caused by the procedure of homogenizing the fuel rods adjacent to water channels as though they were in an infinite lattice. Measurements were made of the dimensional and fuel loading variances along the length as well as around the annular circumference near the axial midsection of the fuel elements used in the critical experiments, and the effect of these non-uniformities on the physics characteristics of the core was determined. The variation of the azimuthal power generation around fuel elements situated adjacent to large water gaps was also measured to determine azimuthal power peaking factors which must be taken into account in the thermal analysis. In addition, criticality measurements were made using flux trap or rectifier control elements. The flux trap control element is essentially a tubular, water-filled control rod consisting of an annulus of neutron-absorbing control material surrounding a central water region. The potential advantages of this element lie in the additional control worth obtained, due to capture of neutrons slowed down in the water hole. Elements of this type were specified in the NUSU reference design. (auth)

15389 (EURAEC-46) CAN-1 QUARTERLY PROGRESS REPORT FOR THE PERIOD JANUARY 15, 1960 TO APRIL 15, 1960. PART A—TECHNICAL REPORT. Quarterly Report No. 1. (Ansaldo S. p. A., Genoa). May 10, 1960. Work Performed under United States–Euratom Joint Research and Development Program. 36p.

The research program for studying injection and separation problems involved in the use of fog (water–steam mixtures) as a reactor coolant is described briefly. A test loop and instrumentation for carrying out the program are described. (D.L.C.)

15390 (GEAP-4080) SODIUM COOLED REACTORS PROGRAM—FAST CERAMIC REACTOR DEVELOPMENT PROGRAM FOURTH QUARTERLY REPORT, JULY–SEPTEMBER 1962. F. J. Leitz, ed. (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Contract AT(04-3)-189. 89p.

The fifth sodium logging capsule was irradiated under the severest test conditions to-date, yet cladding damage did not occur. Experimental design of the Series II capsules is underway and mixed oxide fuel specimens are being fabricated. The FCR sodium loop was operated successfully at design conditions for over 400 hours. Fabrication of hyperstoichiometric uranium dioxide fuel was started. Conceptual design of a compact dynamic sodium capsule was completed. Programmed examination of Series I large diameter UO_2 fuel specimens was completed. Five capsules were irradiated in TREAT and examined to identify incipient failure limits for single and repeated transients. Capsule design for Series II was completed and test assemblies are in the final stages of fabrication. The hazard analysis and test specifications for series II and III were submitted to the manager of the TREAT facility, and testing will proceed as soon as hazards approval is received. Several batches of mixed oxide pellets satisfying density and dimensional specifications were produced for use in the FCR fuel testing program. Equipment is being set up for the purpose of determining the oxygen to heavy metal ratio in mixed oxide fuel by means of the thermogravimetric technique. Scouting studies showed that the plutonium hydroxide-ammonium diuranate precipitate can be directly reduced and sintered to a high density compactable grade oxide in one firing at approximately 1500 C. Post-irradiation examination of high exposure mixed oxide fuel (>70,000 Mwd/t) operated at approximately 20 kw/ft did not reveal gross plutonium migration; the migration observed was within the limits of error, ±10%. Earlier physics calculations on fuel cycles and reactivity coefficients for the FCR reference design were repeated using updated methods and cross sections. The newer cross sections and calculation methods produced an improvement of the fuel cycle economics and a reduction of the Doppler coefficient for the reference core size and composition. Calculations were made to evaluate the effect of composition homogeneity in FCR on the effective absorption cross sections of U^{238} and Pu^{239}. Results indicated that the assumption of a homogeneous core is valid with insignificant error. ZPR-III experimental data on an oxide-fueled assembly were compared with multi-group diffusion calculations using the MISY code and a 21-group cross section set, and SNG transport results show good agreement. Transient calculations using the FORE code indicated that rapid reactivity insertions of over a dollar in EFCR can be adequately simulated by a relatively slow addition using the main control system followed by rapid insertion of the remaining reactivity using the fast reactivity excursion device FORE calculations on the effects of variations in fuel-gap heat transfer coefficients and fuel thermal conductivities is to lessen the severity of an excursion for a given steady-state power and a given reactivity input. (auth)

15391 (GEAP-4155) HIGH POWER DENSITY DEVELOPMENT PROJECT. Quarterly Progress Report No. 11, October–December 1962. R. L. Holladay, comp. (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Jan. 1, 1963. Contract AT(04-3)-361. 71p.

No irradiation accrued on the high power density development fuels during the quarter. A summary of irradiation data and status information is included. Fabrication of 484 swaged pellet fuel rods and 484 swaged powder fuel rods for consumers development fuel assemblies was completed. Development of a new fuel rod ring-type spacer is reported. Data on fabrication stresses in stainless steel cladding were correlated with results of corrosion tests in boiling $MgCl_2$. A relation was established between corrosion crack development in the cladding and the nature of the stress. Completion of the design of a control rod

oscillator system which will consist of a hydraulic servo system to drive the control rods is shown. It was found that the calculation method used for Big Rock Point control rod strength results in underestimation of control rod worth. Other methods are being investigated. Calculations to determine the optimum axial power shape for the Big Rock Point plant are in progress. Several programs associated with the scheduling computer were developed, and input preparation and definition of constants for physics calculations using this computer are nearly complete. Information concerning coordination and test planning is included. (J.R.D.)

15392 (HW-57176) NON-RECYCLE BURNOUT ANALYSIS OF PLUTONIUM FUELS. Status Report– Part A. E. A. Eschbach and J. R. Triplett (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 1, 1958. Contract AT(45-1)-1350. 45p.

Activities in an investigation concerning the relations of cross sections and neutron spectra as they affect the burnup characteristics of Pu are reported. The isotope Pu^{240} is shown to be useful in greater fractional burnups than can be achieved using materials such as U^{238} or Th. Low-enrichment fuel cycles utilizing U^{238} as the fertile material can achieve comparable lifetimes only with efficient neutron economies and with total fuel material requirements of the order of 100 times greater than those necessary with Pu^{240}. On the other hand, U^{235} reactors without fertile material are limited to shorter reactivity lifetimes unless very large quantities of B or similar poisons are employed. (J.R.D.)

15393 (HW-SA-2907) AN APPROACH TO REACTOR CONTROL BY DYNAMIC OPTIMIZATION. Albert L. Ruiz (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 13, 1963. Contract AT(45-1)-1350. 15p.

The synthesis of an optimal control system by dynamic optimization is discussed. A small low-power reactor with a single group of delayed neutrons was assumed. Formulation of the problem, minimizing the performance index, derivation and evaluation of the feedback function, and control system synthesis and computational procedures are described. (M.C.G.)

15394 (NAA-SR-Memo-7577) EFFECTS OF ORGANIC COOLANT ON LAMINATED FIBER GASKET MATERIALS. E. C. Mapes (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 27, 1962. Contract [AT(11-1)-Gen-8]. 3p.

Four commercial laminated fiber type gasket materials were tested in OMRE coolant at 600°F. None of the gaskets proved to be satisfactory for use with the coolant. (auth)

15395 (NAA-SR-Memo-7723) PRELIMINARY DESIGN, REFLECTOR ACTUATOR. R. L. Hall (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 1, 1962. Contract [AT(11-1)-Gen-8]. 76p.

Results of kinetic and kinematic analyses of the S4ER reflector drum are presented. Application of the resulting theoretical derivations serves as a guide both for design and final specification of components. The analyses include a mathematical description of the a-c servo motor and digital servo motor characteristics, a mathematical description of a gear train, a mathematical description of reflector drum dynamics providing for emergency reactor shut-down, and sample calculations applicable to S4ER reflector actuator design. (auth)

15396 (NAA-SR-Memo-7813) A SAFETY FUSE FOR URANIUM CARBIDE FUEL ELEMENTS IN THE S.G.R. CRITICAL ASSEMBLY. J. F. Johnson (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Oct. 16, 1962. Contract [AT(11-1)-Gen-8]. 12p.

Irreversible shutdown of an all-uranium carbide-fueled critical assembly can be obtained by using a low heat solder joint to attach the bottom plate to the bottom of the critical assembly fuel element. Since the assembly may operate at temperatures as high as 400°F, a solder was chosen that would melt at temperatures around 450°F. This will allow fuel to drop out of the element and fall to the grid plate, a distance of approximately 30 inches. The solder selected as a result of a series of experiments, was a 95% tin and 5% antimony alloy. This was found to provide sufficient strength to withstand a weight of 100 pounds and a mild jolting with the sample at 450°F for extended periods of time. At a temperature of 458°F, the sample was observed to have parted after 30 minutes of soaking. (auth)

15397 (NASA-TN-D-1575) TWO-DIMENSIONAL CRITICALITY CALCULATIONS OF GASEOUS-CORE CYLINDRICAL-CAVITY REACTORS. Robert E. Hyland, Robert G. Ragsdale, and Eugene J. Gunn (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Mar. 1963. 28p.

The critical mass of a cylindrical, gaseous-core cavity reactor system was computed with a four-group, two-dimensional diffusion code. U^{235} and Pu^{239} were considered as fuels. Moderator materials investigated were deuterium oxide (at 70°F) and graphite (at 70 and 5300°F). The study was conducted in two parts; the first part considered the effect on critical mass of variable fuel-region radius in a fixed-size cavity, and the second part pertained to specific effects for one particular configuration. The fuel region could be reduced to a radius of 0.20 to 0.33 of the cavity radius with little or no increase in critical mass. For fuel-to-cavity-radius ratios from 0.20 to 1.0 and a graphite moderator at 5300°F, Pu^{239} required about one-third of the critical mass of a U^{235}-fueled system. A hole (simulating an exhaust nozzle) through one end of the reflector-moderator region resulted in an increase in critical mass of 5%. The hydrogen gas, which in nuclear-rocket application would exist between the fuel and moderator regions, was found to have a negligible effect on critical mass. The critical mass was relatively independent of fuel-region temperature and could be computed by evaluating all thermal values at the moderator temperature. (auth)

15398 (NDA-Memo-2126-2) THE ESCAPE OF FISSION FRAGMENTS FROM A DISPERSION TYPE FUEL ELEMENT DUE TO RECOIL. R. Sullivan and H. Soodak (Nuclear Development Corp. of America. White Plains, N. Y.). Nov. 24, 1959. For General Electric Co., Aircraft Nuclear Propulsion Dept., Cincinnati. Contract [AT(30-1)-2303]; Subcontract AT-121. 40p.

The distribution within the fuel element of those fission products which do not escape is of interest. The variables discussed include fuel particle size and volume fraction, presence or absence of clad, clad thickness, and fission product species. (J.R.D.)

15399 (NP-12440) EXPERIMENTAL INVESTIGATIO OF REACTOR KINETICS. P. Jenkinson (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England and United Kingdom Atomic Energy Authority. Production Group, Calder Works, Sellafield, Cumb., England) and D. Smith (United Kingdom Atomic Energy Authority. Reactor Group, Windscale, Cumb., England). 1962. 14p.

The time response of reactors to perturbations from steady conditions is required for the design of control

systems and the evaluation of safety under fault conditions. Measurements can be made on Calder type reactors to test the theoretical models which are used for kinetic calculations and transient studies, and also to evaluate certain reactor parameters. Experiments described include: short-term transients with small perturbations, short-term transient with large perturbation, oscillations, and long-term transients. (M.C.G.)

15400 (NP-12544) SIMULATION OF A MAJOR PIPE RUPTURE IN A PRESSURIZED WATER REACTOR TYPE PLANT. Technical Report 58. M. J. McGoff, S. J. Rodgers, and J. B. McDonough (Mine Safety Appliances Co., Callery, Penna.). Oct. 31, 1957. Contract NObs-65426. 20p.

Pressurized water at 550°F and 1100 psig containing Na^{24}, I^{131}, and Y^{90} as tracers was discharged into a vapor container to simulate a primary system rupture of a pressurized water reactor type plant. Greater than 85% of the contaminants was retained in the vapor container; the magnitude of escape for all runs being of the order of 1% of the initial activity. In runs for minimum retention, greater than 85% of Na^{24}, 95% of I^{131} and 60% of Y^{90} were accounted for and in a maximum retention run, greater than 95% of Na^{24}, 96% of I^{131}, and 72% of Y^{90} were recovered. Trends show that the amount of activity escaping from the containers is related to the retainment conditions. A lesser amount of the soluble products and a greater amount of the insoluble products escaped during runs of maximum retention as opposed to runs of minimum retention. Pressure transients in the vapor container were of the order of 15 psig for blowdown rates of 4.7 lb water per sec and container temperature excursions were localized in areas near the pipe rupture. (auth)

15401 (NP-12553) STUDY ON THE HULL CONSTRUCTION AROUND THE REACTOR OF NUCLEAR SHIPS. (Nuclear-Powered Ship Research Assn. of Japan, Tokyo). Dec. 16, 1961. 117p. (In Japanese)

The hull construction around the marine reactor is important in the study of the hull construction to ensure the safety of nuclear ships. A series of model experiments on hull structure were carried out. Experiments on anti-impact characteristics of high tensile steel plating were concerned with the collision-resistive construction of ship sides. According to the results of collision test of ship-structure models, carried out previously, it was found that the cross stiffened structure with thicker plating than usual was effective from the view point of collision-resistance. Three types of elemental models of cross stiffened structure, square plate, square plate stiffened with single-beam lattice, and square plate stiffened with three-beam lattice, were investigated under impact loading quantitatively. The anti-impact characteristics of high tensile steel plating and those of mild steel plating were compared. The energy absorption of high tensile steel models for unit deflection was greater than that of mild steel models. Thus, improved anti-impact characteristics might be expected by using high tensile steel plating. To protect safely the reactor, when nuclear ship stranding, it is necessary to study the ultimate strength of ordinary double bottom structure. The preliminary experiment for the locally compressive strength of the double bottom structure was projected as follows: instability of double bottom element; instability of single floor element companied with bending; and instability of vertical members in double bottom companied with bending. On loading the vertical member in double bottom structure with compressive force, the mode of failure varies notably due to its load area. Experiments on the synthesis of the containment vessel and the hull construction were performed. When a water-cooled reactor mounted on a nuclear ship suffers a damage by accident, bursting out high pressure steam, there is a danger that the radioactive fusion products come out, too. It is necessary to prevent bursting-out of the nuclear substance in any circumstances. As a measure against this problem, the reactor is generally placed in the high pressure resisting container suspended in the hull as an independent vessel. The volume of the container of this type is limited, and the inner pressure is inevitably high. The weight of the container made of thick plates is naturally heavy. In order to meet this problem, using a part of the hull as a container by constructing the part so as to endure a high pressure was considered. The available volume of the container of this type would be two or three times as large as that of the independent type. However, the inner pressure of the container of this type is over 5 kg/cm^2. The structure of the container enduring this pressure must be much stronger than that of the ordinary hull. The safety factor of this type of construction must be confirmed in order to put it into practice. Therefore, various tests were carried out by using models similar to the actual containers, and analyses were made, based upon the tests results, in order to prepare for construction of future nuclear ships. The first test was made to determine the ultimate strength of the ordinary hull structure of a 70,000 DW tanker. The test results revealed that the buckling of the corner of the transverse web ring is the most important factor in hull construction, and that by improving this part, the strength of the hull would be much increased. It was also found that the safety factor of the structure of the hull should be about 2. The second test was carried out to improve the corner design of the transverse web ring. When the corner radius of the transverse ring was smaller than the web depth, there was little difference in the breaking strength of statical compression even if the corner radius was further decreased. The ultimate strength of the transverse web ring was increased when the tripping bracket was fitted at the corner. Fundamental data concerning the estimation of the ultimate strength of the web ring and the way of increasing the ultimate strength were obtained. (auth)

15402 (NP-12554) ECONOMICS OF THE NUCLEAR AND CONVENTIONAL OIL TANKER. (Nuclear-Powered Ship Research Assn. of Japan, Tokyo). Apr. 1, 1962. 59p. (In Japanese)

A commercial feasibility study of nuclear and conventional vessels at the present stage was performed to give answers to the question of economy of nuclear tanker. The cost studies were based on the cost per ton of cargo and applied to make comparison between nuclear and conventional ships. In addition to this, many data, size of ships, speeds, output, construction costs and stand points of calculations were evaluated and are presented. This study was confined to tankers but a detailed parametric study was performed ranging from about 20,000 to 100,000 tons in dead weight and 12 to 21 knots in sea speed. Results and data are presented. (auth)

15403 (NP-12555) DESIGN STUDIES OF NUCLEAR POWERED TANKER DIRECT CYCLE BOILING WATER REACTOR. (Nuclear-Powered Ship Research Assn. of Japan, Tokyo). Aug. 10, 1962. 284p. (In Japanese)

Design studies of 45,000 DWT tanker utilizing a direct cycle boiling water reactor propulsion system were performed. The objectives of the studies were to find many problems which should be solved in near future and to get data which would be useful for nuclear ship construction.

Design basic conditions are as follows: safety and reduction of capital cost; rules and recommendations of the International Conference on Safety of Life at Sea (1960) and the following regulations, as far as possible, published up to the end of 1961, and regarding the items similar to the conventional ship, the designs are to be satisfied with the regulations of the Ship's Safety law and the rule of the Nippon Kaiji Kyokai; and that this tanker is to be served between Japan and Persia Gulf. (auth)

15404 (NP-12556) REPORT ON SAFETY MEASURES AND THEIR TECHNICAL DESCRIPTION CONCERNING NUCLEAR-POWERED OCEAN OBSERVATION AND SUPPLY SHIP. (Nuclear-Powered Ship Research Assn. of Japan, Tokyo). July 20, 1962. 196p. (In Japanese)

Safety measures for nuclear powered ships are discussed. Topics covered include: outline of reactor design, propulsion apparatus, operation program, accidents of propulsion power apparatus and countermeasures, hull accidents and design condition for countermeasures, and damage estimation. (M.C.G.)

15405 (NP-12557) STUDY ON CODES FOR REACTOR SHIELDING COMPUTATION. (Nuclear-Powered Ship Research Assn. of Japan, Tokyo). Sept. 1, 1961. 241p. (In Japanese)

Detailed descriptions of Japan Shielding Codes Group (SCG) digital-computer reactor shielding analysis programs are presented. These programs may be categorized as follows: gamma attenuation, neutron attenuation, capture gamma ray attenuation, and heating by gamma radiation analysis. The programs are summarized and the type of computer indicated. Each description includes the purpose of the program, the various physical or theoretical assumptions, the used numerical formula of calculation, and the manual of major computer programs. Generally, a total of 10 shielding materials, 20 regions in each material, and source geometry of three kinds, (plane, sphere, and cylinder) can be handled by the programs. SCG Codes were programed for computation on the IBM-650 and NEAC-2203 or FACOM-128 B digital computers. (auth)

15406 (NP-12558) TESTS AND STUDY ON THE EFFECTS OF EXTERNAL FORCE ON REACTOR OF ATOMIC SHIP. [PART] I. (Nuclear-Powered Ship Research Assn. of Japan, Tokyo). Aug. 31, 1960. 201p. (In Japanese)

Studies were made of the effects of external force on the reactor of a nuclear-powered ship. Actual ship tests were made to study acceleration due to oscillation of the ship at sea. (M.C.G.)

15407 (NP-12559) TESTS AND STUDY ON THE EFFECTS OF EXTERNAL FORCE ON REACTOR OF ATOMIC SHIP. [PART] II. (Nuclear-Powered Ship Research Assn. of Japan, Tokyo). Aug. 31, 1960. 143p. (In Japanese)

Studies were made of the effects of external forces on reactors in nuclear-powered ships. Systematic vibration tests were carried out on actual ships. (M.C.G.)

15408 (NP-12560) PROBLEMS ON OPERATION OF NUCLEAR-POWERED SHIP. (Nuclear-Powered Ship Research Assn. of Japan, Tokyo). June 15, 1959. 155p. (In Japanese)

Problems in the operation of nuclear-powered ships are discussed including ports to be entered and cleared, safety control over ship and harbor area, disaster at sea and salvage, laws and regulations, insurance, and international agreement on operation. Problems in accepting Savannah's call are outlined. Domestic and international situations and their relation to operation of nuclear-powered ships are discussed. (M.C.G.)

15409 (NP-12561) FUNDAMENTAL STUDY ON HULL STRUCTURE AROUND REACTOR OF ATOMIC SHIP. (Nuclear-Powered Ship Research Assn. of Japan, Tokyo). Dec. 15, 1960. 160p. (In Japanese)

Effects of the reactor on the structure of the hull of a nuclear-powered ship are discussed. Topics covered include: experiments on collision-resistive structure, experiments on double-bottom lattice structure and on integration of the secondary shield of the reactor with the bulkhead, and studies on integration of the container with hull structure. (M.C.G.)

15410 (NP-12563) STUDY ON THE INFLUENCE OF EXTERNAL FORCES ON THE REACTOR OF NUCLEAR SHIPS— SYSTEMATIC VIBRATION EXPERIMENTS OF ACTUAL SHIPS. (Nuclear-Powered Ship Research Assn. of Japan, Tokyo). Nov. 13, 1961. 77p. (In Japanese)

To obtain data on the external forces acting upon marine nuclear reactor arising from ship vibration, a series of hull vibration tests were carried out on 14 newly built vessels. These vibration tests are divided into following two groups: vibration generator tests during anchoring and hull vibration measurements during speed trials. By these vibration experiments, the vibratory characteristics of test ship were made clear. On the natural frequencies of ship vibration, some kinds of charts estimating fundamental mode were obtained. On the mode curves obtained by vibration generator tests, it can be said that there were little differences among each test ship, so that these data can be applied for determining the suitable position of marine nuclear reactors. (auth)

15411 (NP-12564) STUDY ON THE EFFECTS OF EXTERNAL FORCE ON REACTOR OF NUCLEAR SHIP— ACTUAL SHIP TESTS TO STUDY ACCELERATION DUE TO OSCILLATION AND VIBRATION OF SHIP AT SEA. (Nuclear-Powered Ship Research Assn. of Japan, Tokyo). Dec. 6, 1961. 101p. (In Japanese)

In the design of an atomic power plant to be installed in a nuclear ship, full caution must be paid to the acceleration given rise to by its oscillation. For studies of magnitude of the acceleration, frequency distribution, etc., theoretical calculations were combined with model experiments. This study was undertaken to obtain the maximum value of acceleration due to oscillation and other causes from the survey results on eight voyages of three high-speed cargo ships and one supertanker covering different oceans and seasons in 1959 and 60. The maximum value of acceleration caused by the oscillation in the high-speed cargo ships was estimated at 1.36 g at fore end, 0.45 g at midship, and 1.03 g at aft end in the vertical direction and 0.39 g in the horizontal direction. Fairly large high frequency impact acceleration usually arose sectionally due to whipping in case of the light draft navigation of a high-speed cargo ship in high-speed service. For the general construction, this external force may be ignored, but, for the design of the control and instrumentation system of the nuclear ship, the characteristics of response of the machinery and instruments must be considered. (auth)

15412 (RT/ING(62)-12) CALCOLI DI TRASFERIMENTO DEL CALORE NEL NOCCIOLO DEL REATTORE RAPTUS IN CONDIZIONI STAZIONARIE. (Calculations of Heat Transfer in the Core of a Fast Reactor in Steady State). L. Biasini (Comitato Nazionale per l'Energia Nucleare. Centro di Calcolo, Bologna) and R. Evangelisti (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratorio Ingegneria e Servomeccanismi Reattori, Ispra). Dec. 1962. 44p.

A study was conducted to estimate the steady-state temperature distribution in the core of a fast reactor with reference to the fuel, canning material, and coolant. (auth)

15413 (TID-3561(Rev. 3)) DIRECT ENERGY CONVERSION DEVICES AND SYSTEMS FOR NUCLEAR AUXILIARY POWER (SNAP). A Literature Search. Sidney F. Lanier and Henry D. Raleigh (Division of Technical Information Extension, AEC). Jan. 1963. 63p.

A total of 553 references are listed on the SNAP program and related topics. The references were taken from Nuclear Science Abstracts to Dec. 31, 1962. The contents are arranged in sections on radioisotope-fueled units, reactor-fueled units, direct energy conversion, and general topics on nuclear auxiliary power. (J.R.D.)

15414 (TID-15437) THE TRANSITION FROM SLUG TO HOMOGENEOUS TWO-PHASE FLOWS. Topical Report No. 1. Report No. 304. Raphael Moissis (Dynatech Corp., Cambridge, Mass.). Apr. 18, 1962. Contract AT (30-1)-2907. 26p.

An analysis is presented which describes and predicts the process of transition from the non-homogeneous slug to the homogeneous fog or frothy flow regime in the flow of two-phase mixing in vertical pipes. The results compare favorably with existing visual regime studies. (auth)

15415 (TID-16589) MEASUREMENTS AND INTERPRETATION OF TRANSFER FUNCTIONS AND HYDRODYNAMIC INSTABILITIES IN BOILING LOOP EXPERIMENTS. Quarterly Report for Period Ending June 30, 1962. Report No. 18. S. M. Zivi (Space Technology Lab., Inc. Physical Electronics Lab., Canoga Park, Calif.). June 28, 1962. Contract AT(04-3)-372. 111p.

A report comprising a series of lectures is presented on hydrodynamic stability and power-void transfer functions including the inter-related transfer functions between power, flow, and pressure. It is pointed out that basically non-linear mechanisms can cause hydrodynamic oscillations, and no single theory should be expected to predict all types of instabilities. Coherent oscillations of steam voids are possible even when the inlet flow rate is held constant. (J.R.D.)

15416 (TID-17368) HYDRAULIC CONTROL ROD DRIVE MECHANISM PROTOTYPE PROGRAM. Fourth Quarterly Report for the Period Ending October 31, 1962. R. B. Hussey (American Bosch Arma Corp. American Bosch Div., Springfield, Mass.). Nov. 20, 1962. Contract AT(30-1)-2932. 22p.

The design of the new scram port was refined, and the final hardware is being fabricated. Small recirculating bearings were designed to replace the gimbal drive shoes in the readout shaft and gimbal drive members. Anti-backlash torque on the readout shaft was increased from 5 to 10 inch pounds. Fabrication of the prototype model is 90% completed. Mechanisms in the hydraulic section were tested in 71 full scrams and 11 power-off scrams. (J.R.D.)

15417 (TID-17626) DEPARTURE FROM NUCLEATE BOILING — A SURVEY OF CORRELATIONS APPLICABLE TO THE DESIGN OF THE SM-2. J. J. McNicholas (Alco Products, Inc., Schenectady, N. Y.). [nd]. Contract AT(30-3)-326. 21p. (AP-Note-257)

A survey of recent "Departure from Nucleate Boiling" correlations was made. These correlations are presented and compared. The effects of system variables on DNB heat flux is also discussed in view of special problems associated with reactor design. It is concluded that none of the correlations discussed is completely satisfactory and that an adequate theory for predicting DNB heat flux is still lacking. The qualitative effects of the system variables on DNB are understood but in many instances insufficient data are available for quantitative prediction. It is recommended that the WAPD correlation developed by De Bortoli et al., be used for the prediction of DNB heat flux in the SM-2 design. In transient analysis, the Menegus correlation is considered more useful for predicting DNB heat flux. (auth)

15418 (TID-18081) SOME EARLY REACTOR ACCIDENTS AND THEIR SAFETY IMPLICATIONS. J. A. Bistline (Knolls Atomic Power Lab., Schenectady, N. Y.). [Feb. 15, 1963]. Contract [W-31-109-eng-52]. 11p.

Reactor accidents are usually found to occur due to the following causes, singularly or in combination: untrained personnel, faulty design of equipment, ignoring safety rules and procedures, neglect of equipment, overconfidence in ability and knowledge, and psychologically unfit personnel for reactor operation. Three early reactor accidents and their safety implications are discussed. (H.G.G.)

15419 THE QUESTION OF THE ECONOMY OF DEUTERATED REACTOR COOLANTS. P. Baertschi (Eidgenössisches Institut für Reaktorforschung, Würenlingen, Switzerland). Atomkernenergie, 7: 392-6(Nov. 1962). (In German)

Deuterated organic reactor coolants are basically interesting considering their greater neutron economy and their greater stability as compared to the corresponding normal coolants. Their production and continuous processing in the coolant circuit, however, are much more expensive. It is found that the contribution of coolant investment and make-up to the energy costs is about 3 times higher for D-terphenyls than for the usual H-terphenyls, the higher costs, however, being approximately compensated for by the higher uranium burn-up attainable with deuterated coolants. In addition, their better neutron economy allows a much greater flexibility in the design of fuel elements and reactor cores especially in the case of natural uranium fuel. Due to the higher pyrolytic and radiolytic stability of the D-terphenyls less fouling and somewhat higher operating temperatures can be expected. These potential advantages might lead to more economic power production and justify more detailed investigations as to the production and properties of D-terphenyls. (auth)

15420 INVESTIGATIONS ON THE PYROLYSIS OF POLYPHENYLS. Klaus A. J. Singer, Hilbert Christensen, and Elfinn Larsen (Atomenergiekommission, Risø, Denmark). Atomkernenergie, 7: 397-402(Nov. 1962). (In German)

In connection with the feasibility study of a D_2O-moderated, organic-cooled power reactor, called DOR, at Risø Research Establishment, studies are carried out on the thermal and radiolytic stability of some potential organic coolants. Results are presented concerning the thermal stability at temperatures of 400 to 500°C of the three isomeric terphenyls, as well as of commercial mixtures of these isomers, such as Santowax R, OM 1, OM 2, and OMP. The decomposition is followed through the determination of the gas formation (hydrogen and lower hydrocarbons), through the isomerization of the terphenyls and through the formation of benzene, biphenyl, and higher polyphenyls. The kinetics of the pyrolysis are discussed by comparison of the pure terphenyls and their mixtures, and activation energies are given. (auth)

15421 SIMULATION OF NEUTRON KINETICS WITH AN RC-NETWORK. A. Reinhardt (Kernenergieabteilung der AEG, Ger.). Atomkernenergie, 8: 13-16(Jan. 1963). (In German)

Several amplifiers of an analog computer may be saved if the neutron kinetics is simulated by an RC-network. This network and a number of circuits for various simulation problems are described. (auth)

15422 REACTOR PHYSICS AND CRITICAL EXPERIMENTS AT PETTEN. M. Muysken and M. Bustraan. Atoomenergie Haar Toepassingen, 4: 288-90(Nov. 1962). (In English)

A facility for reactor physics studies and critical experiments in light-water-moderated systems is described. (T.F.H.)

15423 THE SIMULATOR OF THE EDF-1 NUCLEAR POWER PLANT. Gérard Deloux (Études et Recherches d'Électricité, France). Bull. Soc. Franc. Electriciens, (8), 3: 12p.(Jan. 1962). (In French)

The general principles in the construction of the EDF-1 simulator are reported. Some examples are given of the difficulties peculiar to this type of apparatus. Typical examples of the utilization of the simulator are presented. (tr-auth)

15424 AUTOCORRELATION FUNCTIONS OF COUNTING RATE IN BOILING WATER REACTORS. Carlos Vélez (Comision Nacional de Energía Nuclear, Mexico City and Instituto Nacional de la Investigación Científica, Mexico City). Com. Nacl. Energia Nucl. (Mex.), Publ., No. 105 4p.(Nov. 1962). (In Spanish)

The autocorrelation functions of the counting rate in boiling water reactors can be obtained, by means of a general method recently published, on the basis of the kinetic equations for boiling water reactors. The method is applied for the computation of the autocorrelation function for the EBWR at 50 Mw and 600 psig. It is seen that the resulting function is very similar to the one derived from an EBWR power trace simulated by an analog computer. (auth)

15425 NON-DESTRUCTIVE DETERMINATION OF THE COMBUSTION RATE OF A NUCLEAR FUEL. Charles Engelmann, James Gosset, Jean Petit, and Marc Salesse. Compt. Rend., 256: 667-70(Jan. 14, 1963). (In French)

The non-destructive determination of the combustion rate of a nuclear fuel is done by the measurement of the γ activity of one or several fission products. This method was improved by the γ spectrometry of the radiation of Pr^{144}, with energy 2.18 Mev and period 17.5 min, descending from Ce^{144} with a period of 290 days. (tr-auth)

15426 THE DEVELOPMENT OF URANIUM-MAGNOX FUEL ELEMENTS FOR AN AVERAGE IRRADIATION LIFE OF 3000 MWD/te. H. K. Hardy, J. F. W. Bishop, D. O. Pickman, and V. W. Eldred (United Kingdom Atomic Energy Authority, Sellafield, Cumb., Eng.). J. Brit. Nucl. Energy Soc., 2: 33-40(Jan. 1963).

The target irradiation level for the uranium-magnox fuel elements for the electricity generating nuclear power stations was set several years ago. The prediction that 3000 Mwd/te average irradiation lay within the metallurgical life was based on very limited irradiation experience of uranium bars and on restricted information on the mechanical and chemical properties of the magnesium canning alloys. A description is given of the main development programs which have been carried out in order to ensure the endurance of the fuel elements. The main fields dealt with are the cavitational failures, fuel element stability, and can deformations under coolant gas forces, thermal cycling, and the determination of fuel element irradiation performance on a large scale. It is concluded that the major problems on the endurance of the general class of uranium-magnox fuel elements have been overcome successfully and the target irradiation of 3000 Mwd/te channel average is likely to be reached without an undue number of systematic failures. Experience has demonstrated the importance of environmental testing the complete fuel element under conditions which reproduce those in the reactor as closely as possible. There is no substitute for the irradiation testing of fuel elements on a substantial scale and such a program forms an essential part of the development program for fuel elements to be used in large numbers in large nuclear power reactors. The work has been performed in a number of establishments under different managements. The organization has worked smoothly because of close co-operation and good communications between the interested parties, all of whom recognized the need to centralize the main responsibility for the fuel element endurance on one establishment. (auth)

15427 REACTOR ELECTRONICS: I. TRANSISTORS IN REACTOR CONTROL INSTRUMENTS. R. J. Cox and D. Harrison (Atomic Energy Establishment, Winfrith, Dorset, Eng.). J. Brit. Nucl. Energy Soc., 2: 49-58(Jan. 1963).

A new range of control instruments is coming into use on nuclear reactors. The reasons why they all use transistors is not immediately obvious, but is investigated, using the nucleonic instruments designed under the authors' direction as the class of instruments for this study. Some of the new circuit techniques and the reasons for their improved performance are described. (auth)

15428 REACTOR ELECTRONICS: 2. SOLID STATE SAFETY CIRCUITS FOR THE DIMPLE REACTOR. I. Wilson, R. E. Whyard, and A. B. Keats (Atomic Energy Establishment, Winfrith, Dorset, Eng.). J. Brit. Nucl. Energy Soc., 2: 59-73(Jan. 1963).

The introduction of solid state logic circuits operating in a dynamic mode promises greater reliability, reduced maintenance, and considerably enhanced safety of the protection and control system of a nuclear reactor. DIMPLE is the first reactor in the United Kingdom to be so equipped. Development work on solid state logic circuits is reviewed and the factors which determined the design of the DIMPLE system are outlined. The basic circuits are described briefly and their performance over the first few months of operation discussed. (auth)

15429 REACTOR ELECTRONICS: 3. MAGNETIC LOGIC APPLIED TO REACTOR SAFETY CIRCUITS. A. H. Weaving (Nuclear Plant Design Branch, CEGB, London) and J. Sherlock. J. Brit. Nucl. Energy Soc., 2: 74-85 (Jan. 1963).

The requirements for a civil nuclear reactor safety circuit are considered, and a number of design principles are listed. These principles formed the starting point of development work on the application of solid-state switching devices to reactor safety circuits. It was found that multi-aperture ferrite devices fulfilled the requirements for safety circuits and the LADDIC was selected for further development. The LADDIC is a multi-aperture device upon which logic may be performed; its operation and the development of a complete reactor safety circuit are described. (auth)

15430 A STUDY OF PLUTONIUM RECYCLE IN A GAS-COOLED, GRAPHITE-MODERATED REACTOR. [PART] I. Kunihiko Uematsu (Kyoto Univ.). Nippon Genshiryoku Gakkaishi, 5: 7-14(Jan. 1963). (In English)

A fuel cycle analysis of plutonium recycle in a gas-cooled, graphite-moderated reactor was performed

using the fuel cycle code which can be used for IBM 704, 709, or 7090 computer. The fuel cycle variables investigated were three initial uranium enrichments (natural, 1.0, or 1.3 at. %), four plutonium recycle ratios (total, 90%, 75%, or none) and two methods of fuel management (batch irradiation and bidirectional fuel management). Bidirectional fuel management released substantially more energy from a given amount of U^{235} than batch irradiation method. Plutonium recycle not only increased the average burn-up but also improved the peak to average ratio of power density. Poisoning due to Pu^{242} was less severe than had originally been expected. (auth)

15431 ANALYSIS OF THE ENRICHED URANIUM-HEAVY WATER HOMOGENEOUS SYSTEM. Jitsuya Hirota, Satoru Katsuragi, Hideo Kuroi, Reiko Koinuma, and Yukio Ishiguro (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 5: 14-22(Jan. 1963). (In English)

A series of critical experiments was conducted on a system in which heavy water solutions of uranyl sulfate with a U^{238} enrichment of about 20% are surrounded by a heavy water reflector. The deuterium to U^{235} atomic ratios in the solutions ranged from 7,200 to 1,600. In theoretical analysis of the system, leakage of fast neutrons from the core and competition of the leakage with resonance absorption in the core are rather important. Therefore, the resonance escape probability was defined rigorously and a multi-group model was applied to fast and epithermal neutrons. The group constants were determined by averaging over a spectrum which was calculated by the Greuling-Goertzel approximation. The agreement between the theoretical and experimental results are satisfactory except those for perturbation terms. The discrepancies in the effective multiplication factors do not exceed 1%. The spatial distributions of thermal and In-resonance neutron fluxes are well reproduced by the present theory. Agreement of the theoretical cadmium ratios with experimental values indicates that the effects due to the leakage of fast neutrons from the core are treated adequately. (auth)

15432 AN IMPROVED CRITICAL EQUATION IN THE THREE-GROUP DIFFUSION APPROXIMATION. Keiichi Saito, Yasuaki Nakahara, and Takumi Asaoka (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 5: 29-38(Jan. 1963). (In English)

The critical equation in the 3-group diffusion approximation was improved by taking into account all the epithermal reactions. For the effective cross section, Westcott's formulation is followed, wherein the s-factor was modified so as to give the epithermal effect accurately. In connection with evaluating the modified s-factor, simple formulas for the effective resonance integrals of U^{235} and U^{238} were derived for a very dilute homogeneous system and for a natural uranium rod. The present method was applied to the criticality calculation for JRR-3 (Japan Research Reactor No. 3), a natural uranium-heavy water moderated heterogeneous reactor, which went critical on Sept. 13, 1962. The prediction as to the criticality was verified fairly well. (auth)

15433 NEUTRON SPECTRA AND BREEDING POTENTIAL IN SHR. Akira Tachibana, Shigeru Yasukawa, and Takeji Ise (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 5: 51-9(Jan. 1963). (In Japanese)

Fast and thermal neutron spectra in the core of semi-homogeneous reactor were calculated at atom ratios 2,000 to 10,000 for carbon/U^{233} and moderator temperature of 1,200 to 1,800°K. With the obtained spectra and η-233 values measured directly in experiments, effective η-f values and breeding ratios, which are weighted averages of entire core spectra, were obtained. The results are very similar with those of Chernick, et al., of BNL and the breeding ratios were over 1.15 even including Xe^{135} and Sm^{149} poisoning at neutron flux $10^{14}n/cm^2/sec$. It is concluded that solid fuel thermal breeders have possibilities to be realized, depending on the designs which should be very elaborated. (auth)

15434 OPERATING INFORMATION FROM REACTOR NOISE. Joseph A. Thie. Nucleonics, 21: No. 3, 72-5(Mar. 1963).

Analytical techniques used in obtaining information from fluctuations in a reactor's power level are discussed. Use of such analysis to determine the delayed-neutron fraction, power level, stability, degree of subcriticality, and in-operation safety is explained. (D.C.W.)

15435 REACTOR KINETIC APPROXIMATIONS FOR THE EVALUATION OF SAFETY QUESTIONS. Paul Schmid (Eidgenössischen Institut für Reaktorforschung, Würenlingen, Switzerland). Nukleonik, 4: 331-47(Dec. 1962). (In German)

Some of the numerous formulas for the approximate solution of reactor kinetic problems are classified and supplemented. Under special consideration of safety questions, the accuracy and range of applicability of the various methods were investigated. The basic reactor kinetic equations and functions were defined within the framework of an integral concept of the space-independent kinetic theory. They serve as the basis for working out approximations from four different viewpoints. It was shown how the result of a so-called start-up accident can be followed by means of manual calculation methods of the source range up to prompt super-critical states. Precautions, which can be taken, to end power excursions so that the reactor remains intact under the conservative assumption of negligible self-peeling effects are given. (tr-auth)

15436 A MODIFIED PROCEDURE FOR THE EVALUATION OF PULSED SOURCE EXPERIMENTS IN SUBCRITICAL REACTORS. Tsahi Gozani (Eidgenössischen Institut für Reaktorforschung, Würenlingen, Switzerland). Nukleonik, 4: 348-9(Dec. 1962). (In English)

The difficulties encountered in the evaluation of pulsed source experiments in subcritical reactors are reviewed briefly as an introduction to the description of a modified procedure which avoids these difficulties. By using the physical information obtained about the delayed neutrons, instead of rejecting them as background, one can find both reactivity and generation time from the very same pulsed source measurement. If measurements are begun only after the delayed neutron precursors have attained their equilibrium, the reactivity and reduced generation time of the prompt neutrons can be given by very simple approximations. Results obtained in recent experiments using the pulsed source method, the modified source jerk method, and the modified pulsed source method are compared. (J.S.R.)

15437 NUCLEAR REACTOR ENGINEERING. Samuel Glasstone and Alexander Sesonske. Princeton, N. J., D. Van Nostrand Company, Inc., 1963. 842p. $9.20. (TID-17948)

A description of the fundamental scientific and engineering principles related to nuclear reactor systems is presented. The main emphasis is on reactor design and behavior as related to the fission process rather than to engineering areas that are not unique to reactors. (J.R.D.)

15438 CLUSTER ARRANGEMENT OF FUEL ELEMENTS IN AN ATOMIC REACTOR. Jacques-André Stohr and Maurice Gauthron (to Commissariat à l'Énergie Atomique). Canadian Patent 651,277. Oct. 30, 1962. Priority date Aug. 29, 1958, France.

An armature for forming clusters of parallel fuel elements is composed of an external steel band and internal, vertical, cylindrical tubes that are spot-welded together and/or to the belt. Rearrangement of the tube permits accommodation of various numbers of fuel elements. (D.C.W.)

15439 SUPPORTS FOR COMBUSTIBLE ELEMENTS IN ATOMIC PILES OR REACTORS HAVING VERTICAL CHANNELS. Michel Aubert and Roland Roche (to Commissariat à l'Énergie Atomique). Canadian Patent 652,712. Nov. 20, 1962. Priority date Sept. 18, 1958, France.

An improved support for fuel elements in piles or reactors having vertical channels involves fitting the element encasement with large fins that fit slots in the sides and annular, conical base of a shell that, in turn, has a reduced lower end to be inserted into the top of similar shells. (D.C.W.)

15440 SYSTEM FOR SUPPORTING NUCLEAR FUEL IN AN ATOMIC REACTOR OF THE TYPE HAVING VERTICAL DUCTS. Michel Aubert, Roland Roche, and Sébastien Foglia (to Commissariat à l'Énergie Atomique). Canadian Patent 652,721. Nov. 20, 1962. Priority date Nov. 22, 1958, France.

In an improved support system for fuel elements in vertical ducts, the cladded element rests on a graphite ring that is wire-suspended from a shell surrounding the finned element. The shell makes contact with shells of other such assemblies in the vertical tube. (D.C.W.)

Power Reactors

Refer also to abstract 14532.

15441 (ACNP-62832) HAZARDS REPORT— SM-1A CORE II. J. R. Coombe, L. D. Stephenson, and F. G. Moote (Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C. and Allis-Chalmers Mfg. Co., Schenectady, N. Y.). Oct. 18, 1962. Contract AT(30-1)-2639. 13p.

The changes anticipated in the SM-1A reactor by the insertion of SM-1A Core II and the replacement of the startup source are described. The SM-1A Core II components were fabricated to specifications very nearly identical to those of SM-1A Core I. A zero power experiment on SM-1A Core II was conducted, and loading procedures for this core were developed. The nuclear, thermal, and hydraulic characteristics are essentially identical to those of Core I. The insertion of Core II and the replacement of the startup source represent no loss of safety in the operation of the SM-1A. (auth)

15442 (ACNP-62843) STARTUP AND MIDLIFE MOCKUP EXPERIMENTS FOR SM-1, SM-1A, AND PM-2A WITH TYPE 3 ELEMENTS. T. M. Raby, L. D. Walthousen, F. G. Moote, and J. L. Miles (Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C. and Allis-Chalmers Mfg. Co., Schenectady, N. Y.). Jan. 10, 1963. Contract AT(30-1)-2639. 84p.

The use of Type 3 fuel elements in the SM-1, SM-1A, and PM-2A reactors was evaluated by a series of critical mockup experiments. The burnable poison loading to meet required excess reactivity and shutdown margin was determined at core startup conditions. Measurements included control rod bank critical positions, bank calibrations, excess reactivity, shutdown margin for critical bank, stuck rod configurations, flux suppressor worth, temperature defect, and temperature coefficient at operating temperature and pressure. Midlife mockup experiments, made to compensate for fuel burnup, B burnup and fission product poison buildup, were performed to check the excess reactivity and shutdown margin at approximately the most reactive conditions during core lifetime. All cores meet the design requirements for adequate shutdown margin with one control rod fully withdrawn (stuck rod criterion) at any time during core life, and for excess reactivity of at least 3% ΔK at beginning of core life. (auth)

15443 (AECL-1675) DEVELOPMENTS AND TRENDS IN NUCLEAR POWER IN CANADA. J. L. Gray (Atomic Energy of Canada Ltd., Chalk River, Ont.). 1962. 10p.

A status report on the nuclear power program in Canada with a discussion of the probable lines of development and comments on the role the Canadian-type plants will play in the future is presented. (H.G.G.)

15444 (AEEW-R-208) TEMPERATURE COEFFICIENTS OF REACTIVITY IN THE FOURTH LOADING OF ZENITH. R. Caro Manso, R. G. Freemantle, and J. D. Rogers (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Oct. 1962. 61p.

Measurements were made of the temperature coefficients of reactivity associated with the core plus end reflectors and the side reflector of the fourth core loading of ZENITH, which had a C/U^{235} atomic ratio of 7788, and no other absorber. (auth)

15445 (AI-P-1167) HALLAM NUCLEAR POWER FACILITY PREOPERATIONAL TEST COMPLETION REPORT, HOT SODIUM CIRCULATION TEST. P. F. Shaw and L. L. Johnson (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 6, 1962. Contract AT(11-1)-Gen-8. 143p.

Tests were conducted to verify the adequacy of the design, construction, and components of the main heat transfer system of the Hallam Nuclear Power Facility (HNPF) for elevated-temperature and low-power operation. Tests revealed piping interferences, inoperative hangars, and valve difficulties. These discrepancies were rectified and rechecked. Detailed information concerning test results is included. (J.R.D.)

15446 (ANL-6636) HIGH-TEMPERATURE SENSORS FOR BORAX-V BOILING FUEL RODS. E. J. Brooks, W. C. Kramer, and R. D. McGowan (Argonne National Lab., Ill.). Oct. 1962. Contract W-31-109-eng-38. 40p.

The development of sensors for measurement of temperatures to 2760°C in the center of UO_2-fueled, boiling fuel rods for BORAX-V is discussed. Samples of tantalum-sheathed thermocouples with BeO and MgO insulation were tested to failure. Tungsten vs tungsten-26% rhenium was utilized as the thermocouple pair. The first group of thermocouples tested failed at 1650°C. Evaluation of 8 other thermocouples showed that the maximum temperature that they can measure accurately is approximately 2200°C. The limiting factor is the temperature at which a reaction between BeO and Ta begins. (M.C.G.)

15447 (CEND-154) PL-2 COST REPORT. (Combustion Engineering, Inc., Windsor, Conn.). Mar. 16, 1962. Contract AT(11-1)-1062. 37p.

A cost estimate was made for the PL-2 reactor plant installed at a site such as an antarctic snow tunnel. A manpower estimate for erection of the PL-2 plant at a prepared snow tunnel site is included. (J.R.D.)

15448 (CVNA-160) DEVELOPMENT OF SHIELDING FOR CVTR. L. O. Ricks and D. R. Thomas (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Jan. 1962. For Carolinas Virginia Nuclear Power Associates, Inc., Columbia, S. C. Contract AT(30-1)-2289. 63p.

The shielding developed by the Carolinas-Virginia Tube Reactor (CVTR) is described with special attention to the areas of shield design introduced by the use of heavy water as the moderator and coolant in this plant. The development of the reactor top neutron shield as an integral part of the moderator system, complicated by the poor slowing-down power of the heavy water moderator and the development of the paraffin enclosed lead shield cask for the refueling machine to shield against the neutrons generated by the photoneutron reaction in heavy water are emphasized. (auth)

15449 (CVNA-170) CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC. RESEARCH AND DEVELOPMENT PROGRAM QUARTERLY PROGRESS REPORT, OCTOBER–DECEMBER 1962. (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Contract [AT(30-1)-2289]. 28p.

Progress is reported on construction research and development, studies of primary coolant system pressure drop, studies of reactor transients, radiation analysis, thermal and hydraulic core tests, plant nuclear evaluation, sonic inspection of pressure tubes, and metallurgical examination of CVTR components. (J.R.D.)

15450 (DLCS-36402) SHIPPINGPORT OPERATIONS FROM POWER OPERATION AFTER FIRST REFUELING TO SECOND REFUELING, MAY 6, 1960 TO AUGUST 16, 1961. (Duquesne Light Co., Shippingport, Penna. and Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Contract [AT-11-1-GEN-14]. 253p.

A report of Shippingport operation during Seed 2 lifetime is presented. The information is primarily confined to the nuclear portion of the operation. A general review of station performance is given along with details of reactor physics, reactor thermal and hydraulic performance, reactor plant performance and modifications, operational chemistry, and radioactive contamination experience. (J.R.D.)

15451 (DM-69) BREEDERS ARE NOT NECESSARY—A COMPETING OTHER WAY FOR NUCLEAR ELECTRIC POWER. W. B. Lewis (Atomic Energy of Canada Ltd., Chalk River, Ont.). Jan. 15, 1963. 16p. (AECL-1686)

A competive way of producing nuclear electric power is discussed. The general principles of this method are based on conservation of neutrons by making new fissile material and avoiding the processing of radioactive fission products. Only natural U fuel is required, with minor quantities of U^{233} separated for special purposes. No fuel is reprocessed and spent fuel need not be moved. Economic and other comparisons of the method with those involving breeder reactors are made. (J.R.D.)

15452 (GEAP-3947) HIGH POWER DENSITY DEVELOPMENT PROJECT. Eighth Quarterly Progress Report, January–March 1962. R. L. Holladay (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Apr. 1, 1962. Contract AT(04-3)-361. 47p.

Instrumented fuel assemblies were irradiated to 3000 to 5000 Mwd/t and examined for effects of reactor irradiation. The development of fuel fabrication methods and the design of fuel assemblies for the Big Rock Point reactor are reported. Multi-rod burnout data were obtained at 1000 and 1400 psi and mass velocities of 0.56 and 1.13 lb/hr-ft^2. The reduction in reactor axial power peaking factor by poison in the core center was computed. A table of core parameters is presented for the 300-Mw(e) HPD conceptual design core at different power densities and moderator void fractions. (D.L.C.)

15453 (GNEC-267) NUCLEAR SUPERHEAT DEVELOPMENT PROGRAM. Fourteenth Quarterly Progress Report, October–December 1962. S. E. Turner, M. F. Valerino, R. S. Harding (General Nuclear Engineering Corp., Dunedin, Fla.); H. V. Lichtenberger, and C. D. Sedlak (Combustion Engineering, Inc., Windsor, Conn.). Jan. 25, 1963. Contract AT(11-1)-795. 116p.

In the calculational program for physics evaluations, work is reported concerning analysis of criticality data on uniformly-spaced arrays of fuel elements. A two-group formulation is used; the fast group cross sections are obtained by use of MUFT-IV and the thermal group cross sections are based on Maxwellian averages corresponding to ambient water temperature. The heterogeneous resonance integral for the resolved resonances of U^{238} is determined by use of the modified P_3-P_3 method. Thermal disadvantage factors are used for flux- and volume-weightings of the Maxwellian cross sections corresponding to the discrete regions of the unit cell associated with each element. Data obtained in calculations of selected experimental configurations employing uniformly-spaced arrays of fuel elements and covering a wide range of variables are presented. Results of analytical work on individual parameter measurements and on power distributions in assemblies containing heterogeneities such as water channels are included. Design work on the annular multi-tube test element was temporarily halted. Preliminary work is reported on vibratory compaction process. (J.R.D.)

15454 (HPR-28) HBWR QUARTERLY PROGRESS REPORT, JULY TO SEPTEMBER 1962. (Norway. Institutt for Atomenergi. OECD Halden Reaktor Prosjekt). Dec. 1962. 93p.

Operational work during the period was devoted to reactor physics experiments at low power, commissioning of control rods and other components, and minor system changes. Final preparation for the approach to power was initiated. Development and use of an analog computer for HBWR reactivity measurements were reported. Corrosion of stainless steel-clad core instrumentation cabling at high-power operation led to a substitution of Inconel-clad cabling. (J.R.D.)

15455 (IDO-24034) EXPERIMENTAL ORGANIC COOLED REACTOR PRELIMINARY HAZARDS REPORT. (Fluor Corp., Ltd., Los Angeles). Apr. 1, 1960. Contract AT(10-1)-1040. 63p.

The facility will operate at a power level of 30.4 Mw. Analysis of various operating accidents and postulated releases of radioactivity was made. Results of these general studies are the basis of a conclusion that the EOCR is not a significant hazard to off-site personnel. (J.R.D.)

15456 (IDO-24034(Add.)) EXPERIMENTAL ORGANIC COOLED REACTOR PRELIMINARY HAZARDS REPORT (ADDENDUM). (Fluor Corp., Ltd., Los Angeles). Nov. 1960. Contract AT(10-1)-1040. 51p.

Additional design details are presented for use with the EOCR Preliminary Hazards Report (IDO-24034). Information is included which relates the OMRE operating experience to the EOCR. Potential hazards are discussed along with a maximum credible accident. (J.R.D.)

15457 (IDO-24034(Add.2)) EXPERIMENTAL ORGANIC COOLED REACTOR PRELIMINARY HAZARDS REPORT

(ADDENDUM 2). (Fluor Corp., Ltd., Los Angeles). Apr. 1961. Contract AT(10-1)-1040. 122p.

The addendum contains a description of the EOCR system which reflects differences from the conceptual design prepared and presented by Phillips Petroleum Co. in report number IDO-16570. Descriptions are included of the project, the reactor, physics calculations, reactor operations, test programs, and a maximum credible accident. (J.R.D.)

15458 (KR-34) PROBLEMS IN THE PREDICTION OF BOILING WATER REACTOR STABILITY. H. Ager-Hanssen, H. Christensen, and A. Kirchenmayer (Norway. Institutt for Atomenergi, Kjeller). Dec. 1962. 46p.

Stability problems associated with the development of various types of boiling reactors likely to be built in the next 10 years are presented. Problems associated with spatial oscillations in large boiling reactors and those with integral superheat are considered along with power fluctuations in maritime boiling reactors. (J.R.D.)

15459 (NAA-SR-Memo-7512) GASEOUS FISSION PRODUCTS IN POPR COOLANT AFTER FUEL PIN CLADDING FAILURE. J. H. Kendron (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 25, 1962. Contract [AT(11-1)-Gen-8]. 8p.

Activities of all xenon and krypton fission products with half lives of 10 seconds or longer are calculated for a reactor which has operated for 300 days at a power of 160 Mwt. Concentration of fission products at the outlet of a failed fuel element and in adjacent fuel channels and coolant is plotted as a function of time after cladding failure. From this data a resolution curve, which gives the ratio of fission product concentration in a failed fuel channel to that of a normal channel, was drawn. A cladding failure which results in the release of 10% of the fission gases over a period of 10^5 seconds (approximately 28 hours) will cause a coolant buildup of 3.5×10^6 D.P.M. per c.c. in 24 hours. (DPM = Disintegration's per minute). (auth)

15460 (NAA-SR-Memo-7527) VELOCITY DISTRIBUTIONS IN A SNAP REACTOR COOLING CHANNEL. Thermo-Physics Technical Note No. 2. S. R. Fields (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 28, 1962. Contract [AT(11-1)-Gen-8]. 9p.

Methods for determining the velocity distributions in a SNAP reactor coolant channel for both laminar and turbulent flow conditions are presented. The results obtained by applying the methods to SNAP-2 conditions are given as maps of the ratio of local velocity to average velocity in the coolant channel. The use of the velocity distributions in subsequent heat transfer analyses of the fuel rod and coolant system is discussed. (auth)

15461 (NAA-SR-Memo-7673) PROCEDURE FOR DETERMINATION OF OMRE COOLANT COMPONENTS BY HIGH TEMPERATURE GAS CHROMATOGRAPHY. H. E. Keckler (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 28, 1962. Contract [AT(11-1)-Gen-8]. 6p.

The procedure used at the OMRE for coolant component analysis by high-temperature chromatography is described for use as a reference and guide by the technicians actually performing the analysis. (auth)

15462 (NAA-SR-Memo-7676) PIQUA OPERATIONS ANALYSIS PROGRAM. Annual Technical Progress Report, Fiscal Year 1962. H. J. Rubinstein, J. E. Stewart, H. Mandel, D. B. Finch, W. R. McCurnin, and K. E. Neff (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 15, 1962. Contract AT(11-1)-Gen-8. 22p.

Investigations were made on a continuing basis of operation and performance of all portions of the Piqua Plant. Progress is reported in these areas: reactor analysis and shielding, coolant chemistry and analysis, systems and components analysis, fuels and materials analysis, and operating limits and technical specifications. (M.C.G.)

15463 (RT/ING(62)-13) REACTOR KINETICS AND BEHAVIOUR OF NUCLEAR POWER PLANTS UNDER VARIABLE OPERATING CONDITIONS. A. M. Angelini (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). Dec. 1962. 102p.

Reactor kinetics equations derived through a physical approach are presented. The equations are solved by applying operational calculus techniques as established by Giorgi in the areas of reactor startup, and operating conditions characterized by small deviations, and by deviations of any other amplitude from steady-state. (J.R.D.)

15464 (SL-1812) 300 MWe MULTIPLE BOILING SATURATED AND SUPERHEAT STEAM REACTOR PLANT STUDY. (Sargent and Lundy, Chicago). June 24, 1960. For Argonne National Lab., Ill. Contract AT(38-1)-193. 131p.

Information is presented concerning design and construction of a 300 Mwe nuclear power plant using three boiling water reactors operating in parallel as a heat source and a 300 Mwe net nuclear plant using two boiling water reactors operating in parallel in addition to a graphite moderated pressure tube reactor operating in series with the boiling reactors to serve as a heat source for the turbine-generator plant. A brief description of the plant designs considered and their construction costs is included. (J.R.D.)

15465 (SL-1974-3) ENGINEERING EVALUATION STUDIES. HEAVY WATER MODERATED POWER REACTOR PLANTS. Quarterly Progress Report, October–December 1962. (Sargent and Lundy, Chicago). Jan. 10, 1963. Contract AT(38-1)-213. 145p.

Continued computer program work on the economic optimization of D_2O moderated power reactors is reported. The performance and cost data for all the turbine plants and the boiling D_2O, liquid D_2O, and organic plants are complete. Data for 300-, 500-, and 1000-Mw(e) plants are given. An evaluation of the effects of adding fossil-fired superheat to the D_2O-moderated plants is included. (J.R.D.)

15466 (SRO-77) HEAVY WATER POWER REACTOR PROGRAM MONTHLY PROGRESS REPORT, JANUARY 1963. (Savannah River Operations Office, AEC). 10p.

Developmental work on a refueling machine for the CANDU reactor is reported. Other work is reported on development of a boiler test section for CANDU, creep testing of sintered Al products, and ultrasonic testing of Zircaloy fuel sheath tubing. Research is reported on header and feeder piping fluid dynamics, Zr technology, heat transfer, reactor control systems, and fuel fabrication. Operational information concerning HWCTR and CVTR is included. (J.R.D.)

15467 (TID-17706) NUCLEAR TECHNOLOGY DATA FOR SM-1, SM-1A, PM-2A, SM-2. (Alco Products, Inc., Schenectady, N. Y.). June 12, 1961. Contract AT(30-1)-2639. 36p. (AP Note 357)

Tables of nuclear technology data are presented for the SM-1, SM-1A, PM-2A, and SM-2. Tabulations are presented on reactor core loading and geometrical data, core and primary system thermal and hydraulic data, and

primary and secondary shielding data. Also included are drawing lists of all important items covered by the tables. These tables may facilitate comparison of the characteristics of the cores, primary systems, and shields for the four plants and serve as a reference for basic information. (auth)

15468 (TID-18100) COOLANT FLOW DISTRIBUTION PERMEATION OF COOLANT THROUGH GRAPHITE. L. L. Kintner (Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C.). Apr. 5, 1960, Contract [AT (10-1)-925]. 17p. (EGCR-STUDY-II-179-2)

An investigation was conducted to determine the effects of He leakage through EGCR moderator columns and fuel element sleeves on the core coolant flow distribution reported in study II-179-1. Results of the investigation are discussed and recommendations for design changes so that the total coolant bypass will remain the same as previously reported are made. (J.R.D.)

15469 (TID-18104) SHIELDING ANALYSIS OF THE CORE AND PLENUM VIEWING PLUGS. D. Luse (Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C.). May 31, 1960. Contract [AT(10-1)-925]. 39p. (EGCR-STUDY-II-104-2)

A study was conducted to determine the adequacy of the shielding provided in the viewing plug design. Results are presented which show that the dose rate is below the allowable level to within 12 ft of the plug. (J.R.D.)

15470 (TID-18105) SHIELDING ANALYSIS [FOR] CONTROL ROD PLUG. D. F. Luse (Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C.). Aug. 12, 1960. Contract [AT(10-1)-925]. 53p. (EGCR-STUDY-II-104-3)

Results of a shielding analysis for the EGCR control rod plug are presented. Conclusions based on the analysis concerning design are presented. It is noted that the requirements set forth in the study do not consider radiation paths through the primary shield. (J.R.D.)

15471 (TID-18107) NEUTRON SOURCE REQUIREMENTS. P. M. Wood (Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C.). July 6, 1960. Contract [AT(10-1)-925]. 46p. (EGCR-STUDY-II-106-1)

A study was conducted to determine the size of the neutron source required to provide a flux level in the instrument thermal columns for startup of the EGCR. Source requirements calculations are presented for two sizes of thermal columns. (J.R.D.)

15472 (UCRL-7183) MOLYBDENUM ALLOY COMPONENTS OF THE TORY IIA RAMJET REACTOR PROTOTYPE. Peter Mohr (California. Univ., Livermore. Lawrence Radiation Lab.). Jan. 17, 1963. Contract W-7405-eng-48. 31p.

Tory IIA was built and operated to demonstrate the feasibility of a nuclear reactor capable of propelling a supersonic ramjet vehicle. The reactor consisted of a tie-rod- and base-plate-supported nuclear-fueled ceramic heat exchanger. The base plate components discussed were fabricated from 0.5% Ti–Mo alloy and protected with a duplex silicide-oxide coating. Initially, other refractory and high-temperature alloys, ceramics, and cermets were considered for the application. Ultimately, with increased performance requirements and environmental testing experience, the Mo alloy part was chosen for primary service. Cast (SM-200) alloy parts were fabricated as an alternate, however. The Mo alloy parts were fabricated by conventional machining methods from plate forged and rolled from arc-melted ingot. The primary difficulties experienced were related to the detection and control of mill- and machine-induced laminar cracking. Material specification revisions and nondestructive test and quality control measures were employed to define and control these defects. Machining variables are presented along with a short discussion of the coating system used. (auth)

15473 (WAPD-MRP-101) PRESSURIZED WATER REACTOR (PWR) PROJECT. Technical Progress Report, October 24, 1962 to December 23, 1962. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Contract AT(11-1)-Gen-14. 107p.

Core manufacturing continued and several development and design studies were completed. A study was initiated to determine the interaction of various parameters as analyzed by the XITE 1 code, in order to establish criteria as to which channels may be safely excluded from XITE 1 analysis, since it is no longer obvious from physics (input) data which channels will be thermally limiting. Also, a study was completed of the effect on power capability of variations in the thickness dimensions of blanket coolant channels, in order to provide a basis for evaluating manufacturing deviations of this dimension. Preliminary results of cold water accident studies for PWR Core 2 showed that all worst-case secondary plant incidents are tolerable. Initial results of the electron beam welding program indicate generally acceptable corrosion behavior, after short-term testing, of annealed Zircaloy welds. The production autoradiographic technique for detecting mislocated seed fuel wafers was re-evaluated and found to be capable of clearly identifying all wafers of the various zones. The equipment specification for the design and fabrication of the PWR-2 axial flux measurement system was prepared. The design of the poison shipping rods for the Seed 1 fuel assemblies was established. Several modifications to the core instrumentation lock weld designs were considered. The test specification for the Seed 1 reactivity control system alignment test was prepared. Process development work has started on fabrication of Core 2 Seed 2 fuel. Reactor protection setpoints was established based on Core 1 Seed 4 thermal analysis and analog computer studies. The method for modifying the pressurizer surge nozzle is being re-evaluated. The modification was deferred until the plant modification period. Further investigation was carried out on the BEWI piping, removed from PWR during Seed 2-3 refueling, which was not effectively decontaminated by the APAC process. A program to verify the effectiveness of APAC in decontaminating PWR is presented. The 1A reactor coolant pump volute was successfully decontaminated in place by use of an electrolytic descaling technique. The design of the PWR Decontamination System was started. System demineralizers were placed on order; the remaining long-lead-time component specifications are being processed for order placement. A proposed control rod programming scheme was developed for use during Seed 4 lifetime if axial xenon oscillations develop. Core 2 studies were initiated in the development of a nuclear design model suitable for three-dimensional depletion studies for Core 2. Initial experiments with the pre-mockup of PWR-2 Seed 2 are in progress. A loss in control swing between one-rod-withdrawn reactivity and core excess reactivity of 1.7% $\Delta k/k$ was measured at the estimated Seed 2 loading compared to the Seed 1 loading. This estimate is preliminary and does not include the effects of fuel zoning or cold-to-hot reactivity change. The reactivity associated with irradiation-induced changes in volume of samples used in the Irradiated Fuel Reactivity Experiments program was found to be small but not negligible for all samples. Metal-

lographic examination of a fuel plate containing ZrO_2 + 46 wt % UO_2 and ZrO_2 + 36 wt % UO_2 fuel of nominal as-fabricated densities of 70, 80, and 90% of theoretical after 2.5×10^{19} fissions/cc indicated the initial mode of densification of ZrO_2 + UO_2 in-pile. This was attributed to the plastic behavior of the ZrO_2 + UO_2 fuels when subjected to the forces transmitted by the cladding as it is deflected by the pressurized loop water. The experimental conditions were established for obtaining the required compartment diameter and minimum ligament thickness for MCO irradiation samples. Waterlogging tests of rod-type elements (5 in. long × 0.5 in. I.D.) containing 10 and 20% void volume and small (0.003 to 0.010 in.) diameter defects were continued through 19 cycles, after which a uniform swelling of 0.009 in. was observed on one specimen (20% void volume, 0.005 in. hole). The oscillation problem identified during prototype testing of the PWR Core 2 static inverter was resolved and partial manufacturing release for the production static inverters was granted. The Core 2 nuclear protection panel was shipped to Bettis for composite system testing. Manufacturing release was granted for the Core 2 replacement T_c, T_h, and pressurizer thermometers and the core flow d/p cells. The adequacy of the PWR-1 radioactive waste disposal system for PWR-2 operations was established. The flushing criteria for components and piping was approved. The standard for tube weld acceptance for the Foster Wheeler PWR-2 steam generators was revised. The stator windings are being replaced on the PWR-2 main coolant pumps due to inadequate quality of electrical insulation in the lead-in areas. (auth)

15474 (WAPD-PWR-TE-147(Rev.)) REACTOR COOLANT FISSION PRODUCT ACTIVITY. P. W. Frank (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). July 1962. Contract AT(11-1)-Gen-14. 6p.

Results of a test to compare the peaking characteristics of long and short lived fissides during PWR reactor transients are presented. Data are tabulated on the average specific activities in the reactor during the test period, reactor power during the period, and ratio of specific activity in the reactor coolant during the period to the average steady-state activity before the test period. (J.R.D.)

15475 (WCAP-6053) YANKEE CORE EVALUATION PROGRAM QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING DECEMBER 31, 1962. (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Jan. 25, 1963. Contract AT(30-1)-3017. 80p.

The planning efforts for the Yankee Core Evaluation Program are described, a revised sampling plan is suggested, and the progress made on the design and procurement of special equipment for transporting and examining core components is described. Topics covered include: transportation of fuel and control rod; fuel assembly examination; control rod examination; chemical, metallurgical, engineering, and physics evaluations of core performance; and revision of nuclear design methods. (M.G.G.)

15476 (EURAEC-469) IMPROVEMENT OF HEAT TRANSFER IN NUCLEAR REACTORS WITH BOILING WATER. Quarterly Report No. 10. C. Moussez (Société Nationale d'Etude et de Construction de Moteurs d'Aviation, Suresnes, France). Oct. 18, 1962. Work Performed Under United States–Euratom Joint Research and Development Program. Contract 058-61-7RDF. 20p. A translation.

Results of a thermodynamic and thermal study of spinner-equipped fuel elements are reported. Other information is presented concerning hydrodynamic tests on fuel assembly components and low- and high-pressure tests on fuel rod test sections. (J.R.D.)

15477 DEFENSE OF NUCLEAR ENERGY — THE NECESSITY FOR LARGE DEMONSTRATION POWER PLANTS. Wolfgang Finke. At. Strom., 8: 25-9(Apr. 1962). (In German)

The pros and cons in the construction of large demonstration nuclear power plants are briefly reviewed with counter-arguments being given to the objections against such constructions. The high financial risk, high capital investment, and safety problems are discussed. The intervention of the state in alleviating some of these problems is also considered. (J.S.R.)

15478 THE XENON CONCENTRATION IN OPERATION OF A POWER REACTOR. C. Steinert (Atomenergieabteilung der Babcockwerke, Oberhausen, Ger.). Atomkernenergie, 8: 9-12(Jan. 1963). (In German)

The xenon concentration was calculated with a digital computer for a typical power diagram of a power reactor, after the solutions of the differential equations, which describe the xenon behavior, were found. The solutions were led to known integrals of the form $\int_0^\alpha e^{A\xi^B} d\xi$ and restricted to linear power variations. They allowed power diagrams of practical interest to be calculated without an analog computer. (auth)

15479 THE ENTRY OF NUCLEAR ENERGY INTO THE ENERGY MARKET. J. E. Maider. CENUSA (Bol. Centrales Nucl., Soc. Anon.), No. 37, 4-8(July-Sept. 1962). (In Spanish)

In order to show the competitive position of nuclear energy in the energy market at the present time and in the near future, the capital costs, fuel cycle costs, and total energy costs for nuclear power plants are briefly summarized. (J.S.R.)

15480 IMPORTANCE OF THE DEVELOPMENT OF HIGH POWER DENSITY BOILING WATER REACTORS IN OBTAINING CHEAP NUCLEAR ENERGY. D. H. Imhoff and S. Levy. CENUSA (Bol. Centrales Nucl., Soc. Anon.), No. 37, 9-17(July-Sept. 1962). (In Spanish)

The importance of the development of high-power density boiling water reactors is evaluated. The objectives, economic advantages, and actual situation in the development are examined. The reason for the high power density, economic factors in high power densities, the present situation in the development of high power densities, and the importance of continued study in this area are the topics discussed. (J.S.R.)

15481 THE CONDITIONS FOR COMPETITION OF ELECTRIC ENERGY OBTAINED BY NUCLEAR MEANS WITH RESPECT TO ELECTRIC ENERGY OBTAINED FROM OTHER SOURCES. Claudio Castellani. Econ. Intern. Fonti Energia, 5: No. 2, 235-50(Mar.-Apr. 1961).

The difficulties in the cost comparison between conventional and nuclear power plants are first indicated. An attempt is then made to define and express the cost of the energy produced in a thermoelectric power plant and to determine its actual order of magnitude. The cost of the electric energy produced with fuel oils and with nuclear fuels is then shown graphically for hours of utilization and annual percentage utilization. A comparison is then made graphically between the two types of power plants. The factors which would contribute to the energy costs of the two power plants being brought closer together are then discussed. (J.S.R.)

15482 FRENCH GRAPHITE REACTORS. P. Bacher (Centro d'Études Nucléaires, Saclay, France). Energia Nucl. (Milan), 9: 575-80(Oct. 1962). (In Italian)

The development of graphite, natural-uranium reactors in France is described. After showing the different steps

studied in the conception of the EDF-1, EDF-2, and EDF-3 Chinon power plants, the characteristics of the French reactors are emphasized—hollow fuel elements, finned claddings, graphite stacking, and casing in prestressed concrete. The research program is indicated with emphasis on the neutron aspects, and the economic aspects of this reactor type are discussed. (tr-auth)

15483 A METHOD FOR THE ECONOMIC ASSESSMENT OF NUCLEAR POWER REACTORS. C. E. Iliffe and J. K. Wright. J. Brit. Nucl. Energy Soc., 2: 41-8 (Jan. 1963).

A method is described for assessing the relative economic merits of different combinations of various reactor types in an electricity-generating system. The method differs from other methods in that the reactors are considered to be interdependent and the need for assigning a value to plutonium is eliminated. (D.L.C.)

15484 THE STATE OF DEVELOPMENT OF FAST BREEDER POWER REACTORS. D. Falkenberg (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 5: 701-34(Oct.-Nov. 1962). (In German)

As an introduction to a literature survey of the present state of development of fast breeder reactors, the significance of breeder reactors is discussed. The government programs of the U. S., U.S.S.R., England, and France for this reactor type are compared and contrasted. A comparative compilation of data and characteristics of the fast breeders in operation and under construction at the present time is presented. (J.S.R.)

15485 SAFETY DEVICES AGAINST RADIATION INJURIES ON SHIPS OPERATED BY ATOMIC ENERGY. Wolfgang Kirchhoff (Institut fur Kernenergie-Schiffsantriebe Geesthacht-Tesperhude, Postfach, Ger.). Roentgen Bl., 15: 373-9(Dec. 1962). (In German)

On board ship, the impossibility of rapid evacuation results in an increased application of safety measures against the dissemination of radioactive radiation or decay products. With the aid of a multiple superposition of protective barriers an attempt is made to maintain the dosage rates within tolerable limits in rooms necessary for operation also in case of accidents occurring at the reactor. The arrangement of such protective barriers as well as appropriate safety measures are described for a specific ship project. (auth)

15486 THE SCOTT-R DEVELOPMENT PROGRAM. J. H. Wright (Westinghouse Electric Corp., Pittsburgh). Westinghouse Eng., 23: 50-3(Mar. 1963).

Projected turbine generator ratings indicate a need for plants with capacity of 6 to 8×10^6 lb/hr steam at supercritical pressures. SCOTT-R (a 1000-Mw(e) supercritical pressure once-through tube reactor) is a concept designed to fulfill this need, and its parameters are listed. The problem areas which will arise, and the Superheat Development Program and Superheat Power Experiment are described. (D.L.C.)

15487 SERVICE MACHINE (E.G.C.R.) (Engineering Materials). (Oak Ridge Operations Office, AEC). 514 units. (CAPE-971).

The service machine for the Experimental Gas Cooled Reactor is located above the reactor and can handle fuel elements. However, its primary function is to handle control rods, instrumented fuel assemblies, and dropped or jammed components. When used for fuel assemblies it removes one at a time. The machine is designed for minimum lubrication with bearings derated by a factor of 15 from manufacturers ratings. Bearing Hertz stresses are kept below 100,000 psi; contact stresses in the gears are even less. The machine consists of a pressure vessel, bridge and trolley, control console, special tools and instrumentation, and shielding. (D.E.B.)

15488 ELECTRICAL SYSTEM FOR BOILING WATER REACTOR POWER PLANT. A. J. McCrocklin and E. P. Peabody (General Electric Co., San Jose, Calif.). Preprint Paper No. CP-63-501. New York, Institute of Electrical and Electronic Engineers, 1963. 23p. $1.00.

Paper from Winter General Meeting, New York, Jan.-Feb. 1963.

A brief description is given of the power generation cycle and plant auxiliary systems for a dual-cycle boiling-water reactor having a rating of 1425 Mw(th) and an output of 458 Mw(e). The major differences in the electrical systems for this plant and for a fossil-fueled plant are discussed. (D.L.C.)

Production Reactors

15489 (HW-74705) AN ANALYSIS OF HANFORD REACTOR ATMOSPHERE SYSTEMS. J. P. Cooke and R. R. Henderson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 18, 1962. Contract AT(45-1)-1350. 66p.

Information concerning ways of reducing He losses in Hanford Production Reactors is presented. It is noted that a purification system is available that will reduce He loss by 50%. Other devices required include gas holders, atmosphere feed control, atmosphere flow control, and atmosphere analytical equipment. (J.R.D.)

15490 (HW-75139) NPR TUBE-TO-NOZZLE JOINT LEAK TEST WITH SCRATCHED TUBE. D. W. Keefer (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 3, 1962. Contract [AT(45-1)-1350]. 8p.

Tests were conducted to determine the amount of leakage from outside of the Zr tubing through the C steel grooved joint assembly at room temperature and at 550°F. Each tube was scratched 0.010, 0.015, and 0.020 in. and rolled to a 12% wall reduction. Test results are tabulated. (J.R.D.)

Research Reactors

15491 (AERE-M-1163) PERFORMANCE OF THE BEPO SCRUBBER FOR IODINE REMOVAL. F. G. May and J. B. Morris (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Feb. 1963. 13p.

Declassified version of AERE-CE/M-226.

The results of six tests carried out on the I scrubber installed in the BEPO cooling system are described. Under normal conditions the scrubber can remove about 97% of the I from the air flow at shut-down. Addition of artificial nuclei to the air flow reduces the removal efficiency, 30% removal being the worst result of the tests described. An explanation of this effect of the nuclei is suggested. One test with $NaCO_3$ liquor instead of NaOH showed no decrease in removal efficiency. (auth)

15492 (ANL-6650) CRITICAL EXPERIMENTS ON THE JUGGERNAUT REACTOR. J. R. Folkrod and D. P. Moon (Argonne National Lab., Ill.). Dec. 1962. Contract W-31-109-eng-38. 36p.

The experiments are described in sections on approach to critical, control system evaluation, measurements of fuel worth, measurements of reactivity and other coeffi-

cients, flux measurements, power measurements, and measurements of fuel plate, control rod, and graphite temperatures. (J.R.D.)

15493 (CEND-159(Pt.II)) HIGH FLUX BEAM REACTOR BROOKHAVEN NATIONAL LABORATORY. CORE STRUCTURE. L. Bertone, E. Gruber, D. McLaughlin, and J. Pozzato (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). Sept. 1962. For Lummus Co:, New York. Contract AT(30-1)-2697. 106p.

Points of stress concentrations caused by all known loadings are considered. It is concluded that for the conditions considered, the design of the core structure is adequate for its intended purpose. (auth)

15494 (CEND-159(Pt.III)) HIGH FLUX BEAM REACTOR BROOKHAVEN NATIONAL LABORATORY. ENGINEERING ANALYSIS OF THE HFBR THERMAL SHIELD. L. G. Epel, F. W. Kleimola, G. V. Notari, R. J. Rickert, and G. F. Morgenthaler (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). Sept. 1962. For Lummus Co., New York. Contract AT(30-1)-2697. 105p.

The points of stress concentration caused by all known loadings are considered. Thermal stresses resulting from malfunctions of coolant systems are also analyzed. It is concluded that for these conditions, the design of the Thermal Shield is adequate for its intended purpose. (auth)

15495 (CEND-159(Pt.IV)) HIGH FLUX BEAM REACTOR BROOKHAVEN NATIONAL LABORATORY. ENGINEERING ANALYSIS OF BIOLOGICAL SHIELD AND APPURTENANCES. A. A. Correia, L. G. Epel, F. W. Kleimola, G. F. Morganthaler, G. V. Notari, R. J. Rickert, J. F. Rohlin, and D. Zwickler (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). Sept. 1962. For Lummus Co., New York. Contract AT(30-1)-2697. 286p.

A collection of design memoranda concerning the Biological Shield and its appurtenances which are relevant to the completed design is presented. (auth)

15496 (CNLM-4043(Rev.A)) DESIGN CRITERIA FOR LITHIUM-COOLED REACTOR EXPERIMENT (LCRE) AT NRTS. D. T. Hedden (Pratt and Whitney Aircraft Div., United Aircraft Corp., Connecticut Aircraft Nuclear Engine Lab., Middletown). Sept. 4, 1962. Contract AT(30-1)-2789. 62p.

Design criteria are presented for reactor test facilities utilizing existing structures at the former ANP area of the National Reactor Testing Station. The criteria establish the basis for installation, extended testing, and remote disassembly of the 10-Mw LCRE. The site, facility, systems, building services, utilities, and shielding are treated. (D.L.C.)

15497 (CNLM-4190) DESIGN CRITERIA FOR REACTOR TEST SUPPORT FACILITY AT NRTS. D. B. MacFarlane (Pratt and Whitney Aircraft Div., United Aircraft Corp., Connecticut Aircraft Nuclear Engine Lab., Middletown). Sept. 14, 1962. Contract AT(30-1)-2789. 24p.

Design criteria are presented for a technical support facility for the Lithium-Cooled Reactor Experiment and SNAP-50-DR-1 Test Facilities. The criteria establish the basis for the design of laboratories, shops, and engineering areas of the support facility. (D.L.C.)

15498 (IDO-16728) ETR FAST NEUTRON FLUX MEASUREMENTS FOR CYCLE 27. L. D. Weber and C. H. Hogg (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Dec. 31, 1962. Contract AT(10-1)-205. 114p.

The fast neutron fluxes ($\phi > 1$ Mev) in selected positions of the ETR were measured for Cycle 27. Maximum flux values and vertical traverses are shown for all the ETR experimental positions monitored. Measurements were made at the beginning (0 Mwd) and at the end (4467 Mwd) of the cycle. Also, integrated measurements were taken over the complete cycle. (auth)

15499 (NP-12531) THE SCOTTISH RESEARCH REACTOR CENTRE AND ITS FACILITIES FOR THE PRODUCTION AND EXPLOITATION OF SHORT-LIVED RADIOISOTOPES. Alastair Ward (Royal Coll. of Science and Tech., Glasgow). [1962]. 14p.

The Scottish Research Reactor Center is described. The siting, buildings, reactor, and facilities for production and exploitation of short-lived radioisotopes are discussed. Projects suggested involving the use of short-lived radioisotopes are outlined. (M.C.G.)

15500 (ORNL-TM-378) TEMPERATURES IN THE MSRE CORE DURING STEADY-STATE POWER OPERATION. J. R. Engel and P. N. Haubenreich (Oak Ridge National Lab., Tenn.). Nov. 5, 1962. Contract [W-7405-eng-26]. 53p.

Over-all fuel and graphite temperature distributions were calculated for a detailed hydraulic and nuclear representation of the MSRE. These temperature distributions were weighted in various ways to obtain nuclear and bulk mean temperatures for both materials. At the design power level of 10 Mw, with the reactor inlet and outlet temperatures at 1175°F and 1225°F, respectively, the nuclear mean fuel temperature is 1213°F. The bulk average temperature of the fuel in the reactor vessel (excluding the volute) is 1198°F. For the same conditions and with no fuel permeation, the graphite nuclear and bulk mean temperatures are 1257°F and 1226°F, respectively. Fuel permeation of 2% of the graphite volume raises these values to 1264°F and 1231°F, respectively. The effects of power on the nuclear mean temperatures were combined with the temperature coefficients of reactivity of the fuel and graphite to estimate the power coefficient of reactivity of the reactor. If the reactor outlet temperature is held constant during power changes, the power coefficient is -0.018% $(\Delta k/k)$/Mw. If, on the other hand, the average of the reactor inlet and outlet temperatures is held constant, the power coefficient is -0.047% $(\Delta k/k)$/Mw. (auth)

15501 (TID-18026) MEASUREMENT OF VOID EFFECTS IN THE ADVANCED TEST REACTOR CRITICAL EXPERIMENTS. A. L. MacKinney (Babcock and Wilcox Co. Critical Experiment Lab., Lynchburg, Va.). Jan. 1963. For Ebasco Services, Inc., New York. Contract AT(10-1)-1075. 19p. (ATRCE-106)

The effects of voiding various regions of the Advanced Test Reactor Core by inserting teflon or introducing air voids were measured to evaluate effects of possible ATR accidents and to provide calculational checks. Under various conditions in the beryllium reflector, flux traps, experiment mockups, and neck filler region, these voiding effects were measured with balanced and unbalanced control cylinders. Void coefficient profiles through the elements were also made to assist in evaluating temperature changes in the fuel element and local void formation. Positive void effects were noted in the flux traps and experiment mockups. Slight perturbations in the water contained in the cooling holes of the beryllium and the neck shim positions also showed positive effects. Void coefficient profiles, made under a reactor condition having the control cylinders in the lobe studied withdrawn to 120 degrees, revealed positive coefficients outside of the elements and generally negative coefficients within the ele-

ments. Positive void coefficients in the first and last water channels were observed only in Elements 3 and 8. Lumped void coefficient measurements, made in the same positions but having the control cylinders inserted to 5.7 degrees, revealed negative coefficients within the element and positive coefficients for the two outside gaps on either side of the element. (auth)

15502 (TID-18029) POWER DISTRIBUTION MEASUREMENTS OF CLAD ELEMENTS IN THE ATRCE CORE. J. W. Poston (Babcock and Wilcox Co. Critical Experiment Lab., Lynchburg, Va.). Jan. 1963. For Ebasco Services, Inc., New York. Contract AT(10-1)-1075. 28p. (ATRCE-108)

Flux distribution measurements were made in the Advanced Test Reactor Critical Experiment Core containing 10 clad and 30 unclad fuel elements to assist in the ATR design and provide experimental data for comparison with nuclear calculations. With reactor conditions of three and six neck shim rods per neck, flux distribution measurements in the 40 elements, radial measurements in elements 1 to 5, and circumferential measurements in clad element No. 3 were taken. Dysprosium-aluminum foils measured the distributions around the core, but uranium-aluminum foils were used for the fine structure measurements. The average activity in the eight elements that comprised lobe 7 was approximately 50% higher than that in lobe 3 containing the clad fuel elements. Boron-mylar tape attached to the unclad elements reduced the flux shift to approximately 3%. Under the condition of six shim rods per neck, a power-split was not determined because of large flux shift. Utilizing three shim rods per neck, a power-split of 40-65-64 was found. There was little difference between the uranium and dysprosium traverses under the same reactor conditions. The radial, peak-to-average, power generation rate was 1.98 in the experimental core with no corrections for temperature effects, burnable poison distribution, or the increased fuel loading of the actual ATR Core. (auth)

15503 (TID-18076) FLUX AND CADMIUM RATIO MEASUREMENTS IN THE ATR CRITICAL EXPERIMENT. Glenn W. Fiscus (Babcock and Wilcox Co. Critical Experiment Lab., Lynchburg, Va.). Feb. 1963. Contract AT(10-1)-1075. 41p. (ATRCE-107)

The neutron-thermalization effect of water concentration in the flux traps was investigated in 13 ATRCE runs. The dysprosium-cadmium and uranium-cadmium ratios as functions of flux-trap water content in a balanced reference core were measured, and the ratio of the thermal flux in the experimental fuel loading to the thermal flux in the core fuel was evaluated. (auth)

15504 THE LOOP EXPERIMENT FOR ORGANIC LIQUIDS AT THE GEESTHACHT RESEARCH REACTOR. CONSTRUCTION AND FIRST ENGINEERING RESULTS. E. Fischer, G. A. Melkonian, C. Salander, and H. R. Niemann (Reaktorstation, Geesthacht/Elbe, Ger.). Atomkernenergie, 7: 405-10(Nov. 1962). (In German)

A description is presented of the loop-experiment for the irradiation of organic compounds at the Geesthacht Research Reactor. Results and experiences from an extended diphenyl operation are given. (auth)

15505 DESCRIPTION OF THE DUTCH MATERIALS TESTING AND RESEARCH REACTOR. J. Pelser and M. Bustraan. Atoomenergie Haar Toepassingen, 4: 231-41(Nov. 1962). (In English)

The high-flux, pool-type, research reactor has a power of 20 Mw, a thermal flux of 2.4×10^{14} neutrons/cm^2, and a high fast flux. The reactor, vessel, core, control rods, and shielding are described. The experimental facilities—beam tubes, thermal column, rabbit systems, vertical irradiation facilities, etc.—are outlined. The water systems and buildings are discussed. (T.F.H.)

15506 THE INSTRUMENTATION OF THE HFR. P. C. Van Den Berg. Atoomenergie Haar Toepassingen, 4: 242-6(Nov. 1962). (In English)

The nuclear and process instrumentation, nuclear control systems, radiation detection instrumentation, and control room design associated with a 20-Mw, high-flux, pool-type, research reactor are described. (T.F.H.)

15507 PROBLEMS ENCOUNTERED DURING THE CONSTRUCTION AND ERECTION OF THE HIGH FLUX REACTOR AT PETTEN. J. Hamstra and W. Hofman. Atoomenergie Haar Toepassingen, 4: 247-52(Nov. 1962). (In English)

Construction of a 20-Mw, pool-type, materials testing and research reactor is reviewed. (T.F.H.)

15508 NEUTRON BEAM EXPERIMENTS. B. O. Loopstra. Atoomenergie Haar Toepassingen, 4: 253-6 (Nov. 1962). (In English)

Apparatus for studies of neutron time-of-flight spectra, neutron diffraction, neutron inelastic scattering, neutron-capture gamma emission, and neutron radiation damage at 80°K is described. This apparatus is associated with a low-flux and a high-flux research reactor. (T.F.H.)

15509 THE LOW FLUX REACTOR. J. Coehoorn and J. H. B. Madsen. Atoomenergie Haar Toepassingen, 4: 278-81(Nov. 1962). (In English)

A 10-kw, graphite-moderated, low-flux research reactor is described. Attention is given to its general characteristics, shielding, water system, control system, core and reflector, instrumentation, experimental facilities, and operation. (T.F.H.)

15510 OPTICAL MEASURING ORR FOR A NEW TEST LOOP. Anthony A. Abbatiello (Oak Ridge National Lab., Tenn.). Nucleonics, 21: No. 3, 86(Mar. 1963).

Use of a transit-type telescopic instrument fitted with a penta prism to determine the exact dimensions of the Oak Ridge Research Reactor for fabrication and installation of a high-temperature gas-cooled loop in the B-1 core position is described. (D.C.W.)

15511 THE FIRST REACTOR INSTALLATION OF THE REPUBLIC OF SOUTH AFRICA. A. J. A. Roux. S. African Mech. Engr., 12: 29-43(Sept. 1962).

Considerations for the choice of a research reactor for the South African National program are discussed, the final choice being a reactor of the ORR-type, capable of a maximum 20 MW output, but initially to be operated at 6½ MW with a flux density of 4.96×10^{13} n/cm^2 sec. A general description of the reactor, the experimental facilities, the pool structure, the cooling systems and reactor instrumentation and control is given. The building to house the reactor, with its special electrical and ventilation system is also described. The uses to which the reactor will be put are outlined, including the wider implications of the research reactor project. (auth)

SPACE APPLICATIONS AND TECHNOLOGY

Refer also to abstract 14928.

15512 (N62-10946) RESEARCH ON SPUTTERING PHENOMENA, SURFACE STABILITY AND VOLTAGE BREAKDOWN FOR ALKALI-COATED REFRACTORY ELECTRODES. Quarterly Report No. 2, August 1, 1961–October 31, 1961. R. L. Strayer, F. M. Charbonnier, and E. C. Cooper (Linfield Coll., McMinnville, Ore. Research Inst.). Contract NASr-19. 22p.

Studies of voltage breakdown in ion propulsion systems are described. Results of microscopic examinations of Cs deposited on W electrodes indicate that under ion propulsion conditions, Cs intercepted by the electrodes can accumulate and spread readily from the point of impact, thus enhancing the breakdown likelihood by spreading on the electrode support insulation. Plans for examining Cs in sputtering on electrodes in ion propulsion systems are discussed. (J.R.D.)

15513 (N62-11131) MISSION CAPABILITIES OF ION ENGINES. Phase II — Final Report. H. S. London, T. N. Edelbaum, and F. W. Gobetz (United Aircraft Corp. Research Labs., East Hartford, Conn.). Mar. 1962. Contract NAS-935 (R-1297-9).

Payloads and mission times were calculated for space vehicles propelled by ion rockets using nuclear power supplies having specific weights from 10 to 50 lb/kw. Missions studied include low-altitude lunar satellite, low-altitude Venus satellite, solar probe, Saturn probe, and a Jupiter satellite with a circular orbit at the altitude of Jupiter's fourth moon. The variation of payload with the ratio of power supply weight to gross weight was studied and the optimum power levels thereby determined. The ion rocket payload capabilities were compared with those of high-thrust vehicles using H_2-O_2 rockets and W-core nuclear rockets. The performance of high- and low-thrust systems staged in combination was also investigated. Launch vehicles considered in this study were the Atlas-Centaur, the Saturn C-1, and the Saturn C-5. (auth)

15514 (TID-17172) DISPERSAL OF REACTOR CORE MATERIALS BY RE-ENTRY PROCESSES — PRELIMINARY ANALYSIS. J. L. Beal, W. E. Smith, F. C. Haas, and R. L. Pleuthner (Cornell Aeronautical Lab., Inc., Buffalo). July 1962. For Sandia Corp., Albuquerque, N. Mex. Contract 51-1136, Subcontract 7. 38p. (CAL-AA-1506-W1)

An analysis of pertinent re-entry processes is presented. The analysis was made to point out the relative effects of various phenomena on the re-entry disintegration leading to the desired particle size for dispersal. The partition of energy between friction drag (convective heating) and the wave drag is considered along with energy conversion by ablation, heat loss from the body by radiation, and the contributions of oxidation and droplet instability. (J.R.D.)

15515 OPTIMUM THRUST PROGRAMMING OF ELECTRICALLY POWERED ROCKET VEHICLES FOR EARTH ESCAPE. C. R. Faulders (Universite d'Aix-Marseille). AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 233-4(Jan. 1963).

The problem of optimum thrust programming for escape from a satellite orbit is considered for an electrically powered rocket. The equations of motion are treated using variational calculus, and the programs are plotted for thrust-to-weight ratios of 10^{-5} to 10^{-1}. It is seen that for small thrust-to-weight ratios, the programs approach that for specified range and arbitrary final velocity, while for larger ratios, the programs tend toward the optimum curve for specified final velocity and arbitrary range. (D.L.C.)

15516 MAGNETODYNAMIC PROPULSION OF INTERPLANETARY ROCKETS. Jacques C. J. Nihoul. Bull. Soc. Roy. Sci. Liege, 31: 716-28(1962). (In French)

The utilization conditions of magnetopropelled rockets are discussed, and it is shown that the essential characteristics of magnetodynamic systems as well as the flight necessities impose a sharp preference for induction machines with no electrodes. (The conductor fluid plays the role of the "rotor" or the induction machine.) The basic theory of such a machine is then studied on an example of simple geometry. (J.S.R.)

15517 RADIONUCLIDE POWER FOR SPACE. PART 1. ISOTOPE COSTS AND AVAILABILITY. Harold L. Davis. Nucleonics, 21: No. 3, 61-5(Mar. 1963).

Projections of the production of isotopes needed for space power systems reveal a potential shortage of Pu^{238}. Production of Cm^{244} to supplement the Pu^{238} is proposed. Merits of various isotopes as space fuels are weighed, and Pu^{238}, Cm^{244}, Po^{210}, and Cm^{242} are deemed best due to their low shielding requirements. Use of Sr^{90}, Ce^{144}, Pm^{147}, and Cs^{137} is also explored. The future role of private industry in producing the necessary isotopes is also examined. (D.C.W.)

WASTE DISPOSAL AND PROCESSING

Refer also to abstract 14767.

15518 (AHSB(RP)-R-29) A REVIEW OF PROCEDURES FOR DISPOSAL OF RADIOACTIVE WASTE, 1961. H. J. Dunster (United Kingdom Atomic Energy Authority. Authority Health and Safety Branch. Radiological Protection Div., Harwell, Berks, England). Dec. 1962. 37p.

Current procedures for the treatment and disposal of wastes from atomic energy installations and from the industrial and research use of radioactive materials are presented. Quantitative aspects and assessment of the extent to which it is possible to estimate the radiation dose to man resulting from waste disposal are discussed. Published information is insufficient to make any such quantitative estimate, except in two cases: (1) the discharge of liquid radioactive waste from the Windscale Works to the Irish Sea; and (2) the discharges of liquid waste to the Columbia River from the Hanford Operations. (auth)

15519 (CEA-2209) LA DECONTAMINATION DES SURFACES PAR L'EMPLOI DES ULTRA-SONS. (Decontamination of Surfaces by Ultrasonics). P. Cerre, E. Mestre, and J. de Kerdelleau (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1962. 18p.

A study was made of factors such as frequency, intensity, and time in the case of steel and of cotton cloth contaminated by fission products. Results show that the method is only of value in the case of steel and that it is necessary to operate at an optimum frequency of 80 kHz and with an intensity of at least 4 w/cm^2. The difficulty of proposing a valid explanation for the decontamination mechanism is discussed. (auth)

15520 (DLCS-3670101) CATALYTIC HYDROGEN BURNER COMPARISON TEST. CORE I, SEED 2. Test Results. John F. Potter (Duquesne Light Co., Shippingport, Penna.). June 3, 1960. Contract [AT(11-1)-292]. 9p.

Tests were conducted to determine the relative efficiency of the original type catalytic H_2 burner installed in the waste disposal system with a newly installed one. The new type burner was found to be more efficient, and recommendations were made that a similar burner be installed in parallel with the tested equipment. (J.R.D.)

15521 (HW-72285) RECOVERY OF PLUTONIUM FROM INCINERATOR ASHES. M. J. Rasmussen and H. W. Crocker (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 15, 1962. Contract AT(45-1)-1350. 11p.

Two processes were briefly tested and found useful for removal of plutonium from incinerator ashes. Both resulted in plutonium solutions which were compatible with feed requirements for the Recuplex solvent extraction process. The most promising method was the boiling of the ashes in nitric-hydrofluoric acids. Filtering time was negligible. At least 95% plutonium recovery was indicated. The filtration residue (for discard) was about one-fifth of the original ash weight. The alternate method was an ammonium bifluoride fusion followed by dissolution in aluminum nitrate solution. Filtering time was appreciable. The residue weight equalled or exceeded the ash weight. About 84% of the plutonium was recovered by this method. It is possible that the fusion method may be the best where the ashes are rich in plutonium dioxide. The two methods are compatible, so either may follow the other if a second attempt at recovery is ever necessary on the ash residues. (auth)

15522 (HW-73933) REMOTE WELDING CLOSURE FOR WASTE AND FISSION PRODUCT CONTAINERS. Interim Report. V. L. Hammond (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 27, 1962. Contract AT(45-1)-1350. 21p.

The development of processes and equipment for use in packaging long-lived heat-generating isotopes, e.g., strontium-90 and cesium-137, that will be isolated, converted to a stable solid, and stored for long periods of time or bulk shipped is discussed. To accomplish this task, the final product will be packaged in stainless steel containers and welded shut to assure long term containment with high integrity. Development work indicates that the tungsten inert gas welding process is most favorable for remote container closure and argon is recommended as the shield gas. (H.G.G.)

15523 (HW-74927) THE RELEASE OF RADIOCESIUM FROM CLINOPTILOLITE BY ELEVATED TEMPERATURES AND WATER LEACHING. D. L. Reid (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 4, 1962. Contract AT(45-1)-1350. 13p.

The fraction of adsorbed Cs released from crushed clinoptilolite was measured at 590, 800, 1100, and 1350°C. The relations of time as a function of release were determined at 590 to 1350°C. It was found that the release was linear with time below 1100°C. An equation relating time and temperature was developed. Results of leaching tests on fused Cs-clinoptilolite were given. (J.R.D.)

15524 (IDO-14601) PHASE TRANSFORMATIONS IN CALCINATION OF NITRATES OF ALUMINUM, STAINLESS STEEL, AND NICHROME. H. J. Eding, M. L. Huggins, and A. G. Brown (Stanford Research Inst., Menlo Park, Calif.). Dec. 28, 1962. For Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho. Contract AT(10-1)-205. 68p.

Earlier studies showed that low concentrations of boric acid inhibit the formation of alpha alumina in the fluidized calcination of aluminum nitrate wastes. Studies designed to determine the optimum concentration of boric acid and the relative effectiveness of phosphoric acid were performed by heating synthetic mixtures at moderate pressure; results indicated that they were equally effective at the same molal concentration. Differential thermal analysis of mixtures showed that the boric acid reacted with alumina below 183°C. Extraction of boric acid from selected samples indicated that the B was bonded (probably in a random manner, as in glasses) to the alumina rather than to Na. Addition of fission products was studied, and no unusual effects were found. Transformation studies on calcination of stainless steel nitrates indicate that alpha iron oxide is formed even with the addition of moderate amounts of additives such as boric acid, phosphoric acid, aluminum nitrate, or combinations of these. Rare earths are the most effective additive found. Similar studies on nichrome wastes indicate that nickel oxide (crystalline) is formed even with additives. The studies include heating of synthetic mixtures at moderate pressure, differential thermal analysis, and use of a laboratory fluidized calciner. (auth)

15525 (NP-12486) THE PERPETUAL CARE OF HIGH-LEVEL RADIOACTIVE LIQUID WASTES IN NEW YORK STATE. A Technological and Cost Study. R. W. Kupp and S. M. Stoller (Stoller (S. M.) Associates; New York). Oct. 12, 1962. 35p.

The various elements of technology and cost involved in providing care for high-level, radioactive liquid wastes at the Western New York Nuclear Service Center, Cattaraugus County, New York, were analyzed. It was assumed that these wastes are produced in 15 years of operation, at full capacity, of a multi-purpose nuclear fuels reprocessing plant. The technological status of radioactive waste disposal, cost summary, escalation considerations, and calculation of the escrow fund are discussed. (M.C.G.)

15526 ON THE SUBJECT OF THE IMMERSION IN OCEANS AND RIVERS OF RADIOACTIVE WASTES FROM NUCLEAR INSTALLATIONS. F. Le Chuiton, L. Tanon, and A. Besson. Bull. Acad. Natl. Med. (Paris), 145: 340-9(May 9, 1961).

The proposed disposal of radioactive wastes from the Marcoule establishment into the Mediterranean Sea is discussed as well as the general problem of increasing the contamination of the marine environment from all sources of radionuclides (especially fallout from weapons tests, possible pollution from nuclear-powered ships, and radioisotopes used in marine biological studies). (H.H.D.)

15527 SANITARY ENGINEERING ASPECTS OF NUCLEAR ENERGY DEVELOPMENTS. A. W. Kenny (Ministry of Housing and Local Government, London). Bull. World Health Organ., 26: 475-94(1962).

Consideration is given to specific points in the latest recommendations of the International Commission on Radiological Protection in relation to public drinking-water supplies and the problem of fallout, with special references to the presence and significance of Sr^{90} in drinking water is examined. A general survey of the various uses of radioactive materials is followed by a discussion of the legislative and control measures necessary to ensure safe disposal of wastes. The methods of waste disposal adopted in a number of nuclear energy establishments are described in detail. Some concluding remarks are given on solid waste disposal, siting of nuclear energy industries, and area monitoring. (Public Health Eng. Abstr., 42: No. 12, 1962)

15528 RADIOACTIVE WASTES AND THEIR ELIMINATION. H. Weiss (Staatlichen Zentrale für Strahlenschutz, Rossendorf, Ger.). Isotopen Tech., 2: 368-73(Dec. 1962). (In German)

The possibilities for the elimination of radioactive wastes are described. Methods for the elimination of low-activity wastes, which are of great interest in the laboratories of the DDR, are especially treated extensively. (tr-auth)

15529 FIXATION OF RADIOACTIVITY IN SOLID MEDIA: STABILITY OF GLASSES AND GLAZES. Galen R. Frysinger (Arthur D. Little, Inc., Cambridge, Mass.) and Henry C. Thomas. Nature, 197: 352-3(Jan. 26, 1963).

A standard leaching test employed for the evaluation of the stability of glasses and glazes was used to test the fixation of radioactivity in solid media. Results are reported from preliminary tests of the leaching apparatus and from tests using samples of glass prepared with small added amounts of Cs^{137} tracer. The release of activity was found to be proportional to the area of the exposed surface. It was concluded that the amount of radioactive isotope required in a test specimen would vary with the nature of the isotope and the type of measuring equipment available to the operator. (C.H.)

15530 GAMMA EMITTERS IN MARINE SEDIMENTS NEAR THE COLUMBIA RIVER. Charles Osterberg, L. D. Kulm, and John V. Byrne (Oregon State Univ., Corvallis). Science, 139: 916-17(Mar. 8, 1963).

Samples from sediment cores collected at 26 different locations 5 to 35 miles offshore in and around Astoria Submarine Canyon were analyzed for gamma emitters. Chromium-51 and zinc-65 were the principal radionuclides found, although several fission products and natural potassium-40 were also present. Radioactivity fell off sharply with distance from the mouth of the Columbia River, indicating that the river serves as a common source of the artificial radionuclides. (auth)

15531 RADIOACTIVE WASTES AND THEIR HANDLING. O. Peraekylae. Vesitalous, 3: 20-5(1962).

A review is presented on the volumes and types of radioactive waste waters produced in the generation of nuclear energy and in the various uses of radioactive isotopes. So far only small volumes of radioactive wastes are produced in Finland and no difficulty has arisen in their disposal. Methods used in other countries for the treatment and disposal of such waste waters are outlined. (Public Health Eng. Abstr., 42: No. 12, 1962)

CORPORATE AUTHOR INDEX

This index contains entries for all report literature and, in addition, for certain published literature items for which it is felt that a corporate approach is especially desirable, e.g., symposia, conference proceedings, and meetings.

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The phrase "Progress report" is abbreviated as "Prog. rpt." This change permits a more rapid and complete alphabetical arrangement of the titles without changing the location of the progress report titles in relation to the other titles.

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ä	becomes	ae
ö		oe
ø		oe
ü		ue (except in transliterated Chinese names)

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NAS	National Academy of Sciences, National Research Council, Washington 25, D. C.
NRC	For sale by the National Research Council of Canada, Ottawa, Ontario, Canada.
OTS	For sale by the Office of Technical Services, Department of Commerce, Washington 25, D. C.
USGS	Available free-of-charge from the U. S. Geological Survey, Washington 25, D. C.

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213	17-14923	$4.60(OTS)
ACNP–		
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62832	17-15441	Dep.(mc); $1.60(fs), $0.80(mf) OTS
62843	17-15442	Dep.(mc); $8.10(fs), $2.72(mf) OTS
AD–	**(Misc.)**	
272853*	17-13916	See ARF-3170-6
273095*	17-13962	See ASD-TR-61-510
275762*	17-15342	$8.10(OTS)
277410*	17-14599	See NRL-5807
277562*	17-15343	$5.60(OTS)
277946*	17-13961	$2.60(OTS)
278119*	17-15374	$3.60(OTS)
278253L*	17-14305	
278419*	17-14306	$2.60(OTS)
278451*	17-14924	$1.10(OTS)
278452*	17-14801	$1.60(OTS)
278475*	17-15055	See RM-3144-PR
278480*	17-14927	See AGC-0528-01-2
278727*	17-14802	$2.60(OTS)
278810*	17-14928	See ASD-TDR-62-324
278816*	17-14934	See GA-3330
278817*	17-14925	$2.60(OTS)
278821*	17-14723	$2.60(OTS)
278844*	17-14929	See ASD-TDR-62-598
283118*	17-14529	See MRL-TDR-62-29
283485*	17-14923	See AASU-213
283594*	17-14811	See ASD-TDR-61-529
284059*	17-14530	See MRL-TDR-62-46
284409*	17-14812	See ASD-TDR-62-181
285214*	17-14776	$2.60(OTS)
285236*	17-14853	See WADD-TR-60-581(Pt.III)
290358*	17-14531	See NDL-TR-32
295053*	17-14932	See CX-59
295864*	17-13967	See NP-12484
296291*	17-13978	See NP-12535
296419*	17-14778	See ASD-TR-7-532a(IX)
296435*	17-14316	See USNRDL-TR-607
296597*	17-14480	See RM-3386-PR
296759*	17-14809	See ARF-B231-8
296812*	17-14533	See NP-12534
296893*	17-14926	$6.60(OTS)
296931*	17-15350	See RM-3440-PR
297032*	17-14308	See AGN-AN-847
297178*	17-14777	$6.60(OTS)
297345*	17-14477	See NRL-5869
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5652	17-14379	Dep.(mc); $3.60(fs), $1.40(mf) JCL
5663	17-14745	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS
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5668	17-14221	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
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5675	17-14618	Dep.(mc); $2.60(fs), $0.86(mf) JCL
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5679	17-14223	Dep.(mc); $1.60(fs), $0.80(mf) JCL
5683	17-14224	Dep.(mc); $3.60(fs), $1.13(mf) JCL
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1663	17-14729	See CRGN-1106
1670	17-14204	See CRL-76
1675	17-15443	Dep.; $0.50(AECL)
1686	17-15451	See DM-69
1687	17-14519	Dep.; $0.50(AECL)
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23	17-14520	Dep.(mc)
AEET-ANAL–	**(Indian)**	
3	17-14307	Dep.(mc)
AEET-HP–	**(Indian)**	
R-11	17-14521	Dep.(mc)
AEET-NP–	**(Indian)**	
5	17-15312	Dep.(mc)
AEEW-M–	**(British)**	
211	17-15183	See BNL-719(Vol.II)(p.592-609)
268	17-14641	Dep.; $0.42(BIS); 3s. (HMSO)
281	17-14642	Dep.(mc)
286	17-15158	Dep.; $0.35(BIS); 2s. 6d. (HMSO)
AEEW-R–	**(British)**	
170	17-14643	Dep.; $0.98(BIS); 7s. (HMSO)
208	17-15444	Dep.; $1.12(BIS); 8s. (HMSO)
212	17-15159	Dep.; $0.56(BIS); 4s. (HMSO)
AERE-AM–	**(British)**	
93	17-14133	Dep.; $0.25(BIS); 1s. 9d. (HMSO)
AERE-CE–	**(British)**	
M-226	17-15491	For Decl. Vers. see AERE-M-1163
AERE-M–	**(British)**	
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1115	17-14804	Dep.; $0.16(BIS); 1s. 2d. (HMSO)
1163	17-15491	Dep.
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4101	17-15247	Dep.; $0.77(BIS); 5s. 6d. (HMSO)
4114	17-14197	Dep.; $1.68(BIS); 12s. (HMSO)
4123	17-14198	Dep.; $0.98(BIS); 7s. (HMSO)
4137	17-14522	Dep.; $0.42(BIS); 3s. (HMSO)
4141	17-14134	Dep.; $0.98(BIS); 7s. (HMSO)
4149	17-14199	Dep.; $0.56(BIS); 4s. (HMSO)
4210	17-14135	Dep.; $0.35(BIS); 2s. 6d. (HMSO)
4227	17-15248	Dep.; $0.35(BIS); 2s. 6d. (HMSO)
4250	17-14711	Dep.; $1.12(BIS); 8s. (HMSO)
AERE-Trans–	**(British)**	
899	17-14748	Dep.
905	17-14317	Dep.
913	17-14861	Dep.
915	17-14425	Dep.
921	17-15355	Dep.
923	17-14225	Dep.
924	17-15356	Dep.
AF–	**(Non-AEC)**	
95	17-15342	See AD-275762
AFCRL–	**(Non-AEC)**	
62-1089	17-14932	See CX-59

Report No.	Abstract No.	Availability
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AGN-AN–	**(Non-AEC)**	
847	17-14308	$13.50(OTS)
AGN-TM–		
401	17-14200	Dep.; $1.75(OTS)
AHSB(RP)-R–	**(British)**	
29	17-15518	Dep.; $0.77(BIS); 5s. 6d. (HMSO)
Al-P–		
1167	17-15445	Dep.(mc); $11.00(fs), $4.49(mf) OTS
AMRL-TDR–	**(Non-AEC)**	
62-86	17-15052	$3.50(OTS)
ANL–		
6562	17-14114	Dep.; $3.50(OTS)
6596	17-14115	Dep.; $3.00(OTS)
6636	17-15446	Dep.; $1.00(OTS)
6650	17-15492	Dep.; $0.75(OTS)
6653	17-14445	Dep.; $1.00(OTS)
6660	17-14446	Dep.; $0.50(OTS)
6661	17-15384	Dep.; $1.25(OTS)
6663	17-14201	Dep.; $0.75(OTS)
6683	17-15385	Dep.; $1.50(OTS)
AP-Note–	**(Misc.)**	
257	17-15417	See TID-17626
357	17-15467	See TID-17706
ARF–	**(Misc.)**	
2158-3	17-14825	See LAR-12
2158-6	17-14826	See LAR-14
2158-9	17-14827	See LAR-17
2158-12	17-14805	Dep.(mc); $6.60(fs), $2.21(mf) OTS
2158-15	17-14724	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2158-18	17-14806	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2158-21	17-14807	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2158-24	17-14808	Dep.(mc); $5.60(fs), $1.91(mf) OTS
3170-6*	17-13916	OTS
3187-7	17-14523	Dep.(mc); $1.10(fs), $0.80(mf) OTS
3187-11	17-14524	Dep.(mc); $5.60(fs), $1.76(mf) OTS
ARF-B–	**(Misc.)**	
231-8*	17-14809	$1.60(OTS)
6005-2	17-14810	Dep.(mc); $1.10(fs), $0.80(mf) OTS
AROD–	**(Misc.)**	
2360.23*	17-14932	See CX-59
ASD-TDR–	**(Non-AEC)**	
61-529	17-14811	$5.00(OTS)
62-181	17-14812	$1.00(OTS)
62-324	17-14928	$3.00(OTS)
62-598	17-14929	$2.75(OTS)
ASD-TR–	**(Non-AEC)**	
7-532a(IX)	17-14778	$10.50(OTS)
7-840A(VIII)	17-14308	See AGN-AN-847
61-510	17-13962	OTS
61-674	17-13916	See ARF-3170-6
ATRCE–		
106	17-15501	See TID-18026
107	17-15503	See TID-18076
108	17-15502	See TID-18029
BAW–	**(Misc.)**	
1181	17-14447	Dep.(mc); $10.50(fs), $4.37(mf) OTS
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8147	17-14202	Free(Bureau of Mines)
BM-RI–	**(Misc.)**	
5886*	17-15386	Free(Bureau of Mines)
6180*	17-14813	Free(Bureau of Mines)
6195*	17-14726	Free(Bureau of Mines)
6198*	17-14203	Free(Bureau of Mines)
6205*	17-14375	Free(Bureau of Mines)
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1600(Del.)	17-14727	Dep.; $2.00(OTS)
1603(Del.)	17-13876	Dep.; $2.00(OTS)
1616	17-14814	Dep.; $1.00(OTS)
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203	17-14779	Dep.(mc); $1.60(fs), $0.80(mf) OTS
218	17-14763	Dep.(mc); $3.60(fs), $1.37(mf) OTS
10030	17-14764	Dep.(mc); $1.10(fs), $0.80(mf) OTS
10031	17-14815	Dep.(mc); $1.10(fs), $0.80(mf) OTS
10032	17-15387	Dep.(mc); $1.10(fs), $0.80(mf) OTS
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6207-02	17-14749	See EURAEC-408
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719(Vols.I,II, III, and IV)	17-15160	Dep.; $15.00(OTS)
736	17-14765	Dep.; $1.00(OTS)
5659	17-14038	Intern. Rev. Cytol. 13: 221-321(1962)
6186	17-13963	Dep.(mc); $2.60(fs), $0.89(mf) OTS
6202	17-13964	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6260	17-15295	Nucl. Phys. 40: 167-76(1963)
6290	17-14669	Nucl. Instr. Methods 21: 1-16(1963)
6393	17-15200	See BNL-719(Vol.III)(p.1034-73)
6403	17-14973	J. Chem. Phys. 38: 832-6(1963)
6475	17-14441	Rev. Sci. Instr. 34: 194-6(1963)
6643	17-14087	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6704	17-13965	Dep.(mc); $2.60(fs), $0.98(mf) OTS
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6765	17-15249	Dep.(mc); $3.60(fs), $1.19(mf) OTS
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6773	17-14310	Dep.(mc); $3.60(fs), $1.22(mf) OTS
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6808	17-15315	Dep.(mc); $1.10(fs), $0.80(mf) OTS
6823	17-15316	Dep.(mc); $3.60(fs), $1.31(mf) OTS
6825	17-14888	Dep.(mc); $1.10(fs), $0.80(mf) OTS
6827	17-14644	Dep.(mc); $1.10(fs), $0.80(mf) OTS
BNL-T–		
265	17-14765	See BNL-736
CAL-AA–		
1506-W1	17-15514	See TID-17172
CAPE–		
971	17-15487	
CEA–	**(French)**	
2186	17-14816	Dep.(mc)
2197	17-14448	Dep.(mc)
2199	17-15250	Dep.(mc)
2202	17-14136	Dep.(mc)

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2207	17-14088	Dep.(mc)
2209	17-15519	Dep.(mc)
2214	17-14706	Dep.(mc)
2222	17-14728	Dep.(mc)
2223	17-14526	Dep.(mc)
CEA-Bib–	**(French)**	
33	17-14930	Dep.(mc)
CEA-tr–	**(French)**	
A-1164	17-14707	Dep.(mc); $1.60(fs), $0.80(mf) JCL
A-1227	17-14226	Dep.(mc); $1.10(fs), $0.80(mf) JCL
A-1229	17-14708	Dep.(mc); $1.60(fs), $0.80(mf) JCL
X-455	17-14153	Dep.(mc); $1.10(fs), $0.80(mf) JCL
X-485	17-14154	Dep.(mc); $5.60(fs), $1.97(mf) JCL
X-488	17-14318	Dep.(mc); $2.60(fs), $0.89(mf) JCL
CEND–	**(Misc.)**	
154	17-15447	Dep.(mc); $3.60(fs), $1.31(mf) OTS
156	17-14780	Dep.(mc); $6.60(fs), $2.24(mf) OTS
159(Pt.II)	17-15493	Dep.(mc); $9.10(fs), $3.38(mf) OTS
159(Pt.III)	17-15494	Dep.(mc); $9.10(fs), $3.35(mf) OTS
159(Pt.IV)	17-15495	Dep.(mc); $18.00(fs), $8.76(mf) OTS
167	17-15388	Dep.(mc); $9.10(fs), $3.26(mf) OTS
172	17-14817	Dep.(mc); $7.60(fs), $2.42(mf) OTS
CERN–	**(European Organization for Nuclear Research)**	
63-1	17-15071	Dep.(mc)
CERN-NPA–	**(European Organization for Nuclear Research)**	
Int-61-5	17-15317	
CLM-Bib–	**(British)**	
3	17-14931	Dep.; $0.35(BIS); 2s. 6d. (HMSO)
CLM-R–	**(British)**	
24	17-15344	Dep.; $1.12(BIS); 8s. (HMSO)
CLOR–	**(Polish)**	
12	17-14471	Dep.(mc)
CNLM–		
4043(Rev.A)	17-15496	Dep.(mc); $6.60(fs), $2.06(mf) OTS
4190	17-15497	Dep.(mc); $2.60(fs), $0.92(mf) OTS
CREL–	**(Canadian)**	
1009(Pt.2)	17-14712	Dep.; $2.00(AECL)
CRGM–	**(Canadian)**	
1106	17-14729	Dep.; $1.00(AECL)
CRL–	**(Canadian)**	
76	17-14204	Dep.; $1.00(AECL)
CTSL–		
38	17-15072	Dep.(mc); $2.60(fs), $0.98(mf) OTS
CU(PNPL)–		
220	17-15251	Dep.(mc); $5.60(fs), $1.85(mf) OTS
CVNA–	**(Misc.)**	
160	17-15448	Dep.(mc); $6.60(fs), $2.09(mf) OTS
170	17-15449	Dep.(mc); $2.60(fs), $1.04(mf) OTS
CX–	**(Non-AEC)**	
59	17-14932	$4.60(OTS)
DEG-Inf. Ser.–	**(British)**	
146	17-14227	Dep.
DESY-A–	**(German)**	
2.95	17-15318	Dep.(mc)
DLCS–		
36402	17-15450	Dep.; $3.50(OTS)
3670101	17-15520	Dep.(mc); $1.10(fs), $0.80(mf) OTS
DM–	**(Misc.)**	
62-124*	17-14140	See N62-11516
69*	17-15451	Dep.; $0.50(AECL)
DP–		
619	17-14137	Dep.; $0.50(OTS)
800	17-14645	Dep.; $0.50(OTS)
812	17-14415	Dep.; $1.75(OTS)
DRI–	**(Misc.)**	
2039*	17-14818	$1.60(fs), $0.80(mf) OTS
DUBNA REPORTS	**(Russian)**	
See JINR (Russian)		
EANDC(OR)–	**(European-American Nuclear Data Committee)**	
19(L)	17-14933	
EANDC(US)–	**(European-American Nuclear Data Committee)**	
28(L)	17-15252	
EFINS–	**(Misc.)**	
60-70	17-15116	Nuovo Cimento (10) 26: 1109-27(1962)
62-5(Rev.)	17-15073	Dep.(mc); $2.60(fs), $1.01(mf) OTS
62-17	17-15074	Dep.(mc); $1.60(fs), $0.80(mf) OTS
62-34	17-14439	Rev. Sci. Instr. 34: 188-90(1963)
EGCR-STUDY-II–		
104-2	17-15469	See TID-18104
104-3	17-15470	See TID-18105
106-1	17-15471	See TID-18107
127	17-14616	See TID-18103
179-2	17-15468	See TID-18100
EURAEC–		
46	17-15389	Dep.(mc); $3.60(fs), $1.28(mf) OTS
408	17-14749	Dep.(mc); $10.10(fs), $4.07(mf) OTS
422	17-14731	See GEAP-3979
428	17-14780	See CEND-156
454	17-14732	See GEAP-4051
459	17-14750	Dep.(mc); $14.00(fs), $6.44(mf) OTS
469	17-15476	Dep.(mc); $1.60(fs), $0.80(mf) OTS
478	17-14751	Dep.(mc); $5.60(fs), $1.73(mf) OTS
490	17-14752	Dep.(mc); $4.60(fs), $1.67(mf) OTS
515	17-14862	Dep.(mc); $2.60(fs), $0.86(mf) OTS
543	17-14414	See ACNP-62033
544	17-14815	See BMI-X-10031
546	17-14764	See BMI-X-10030
547	17-15387	See BMI-X-10032
558	17-14653	See WCAP-2175
579	17-14769	See NMI-1908
583	17-14817	See CEND-172
GA–	**(Misc.)**	
2988	17-15206	See BNL-719(Vol.IV)(p.1232-54)
3024	17-15163	See BNL-719(Vol.I)(p.69-99)
3085	17-15197	See BNL-719(Vol.III)(p.946-65)
3330*	17-14934	$1.60(OTS)
3409	17-15213	Dep.; $1.50(OTS)
3422	17-15067	Dep.(mc); $7.60(fs), $2.33(mf) OTS
3599	17-14889	Dep.(mc); $5.60(fs), $1.76(mf) OTS
3724	17-14890	Dep.(mc); $1.10(fs), $0.80(mf) OTS
3845	17-14730	Dep.(mc); $2.60(fs), $0.92(mf) OTS
3873*	17-14935	
3874	17-15253	Dep.(mc); $6.60(fs), $2.21(mf) OTS

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3882	17-14891	Dep.(mc); $1.10(fs), $0.80(mf) OTS
GEAP–	**(Misc.)**	
3766	17-14449	Dep.; $3.00(OTS)
3947	17-15452	Dep.(mc); $4.60(fs), $1.61(mf) OTS
3979	17-14731	Dep.; $2.50(OTS)
3997	17-14781	Dep.; $1.00(OTS)
4017	17-15214	Dep.; $2.25(OTS)
4051	17-14732	Dep.(mc); $1.60(fs), $0.80(mf) OTS
4058	17-14733	Dep.; $1.25(OTS)
4080	17-15390	Dep.; $2.00(OTS)
4155	17-15391	Dep.(mc); $7.60(fs), $2.33(mf) OTS
GEST–	**(Misc.)**	
2009*	17-14819	
GNEC–		
267	17-15453	Dep.(mc); $9.60(fs), $3.68(mf) OTS
HNS–		
10	17-14481	See TID-17518
HPR–	**(Norwegian)**	
28	17-15454	Dep.(mc)
HW–		
57176	17-15392	Dep.(mc); $4.60(fs), $1.55(mf) OTS
57581(Del.)	17-14416	Dep.(mc); $1.10(fs), $0.80(mf) OTS
58312(Rev.)	17-14472	Dep.(mc); $1.60(fs), $0.80(mf) OTS
67067	17-14138	Dep.(mc); $1.10(fs), $0.80(mf) OTS
68067(Rev.1)	17-14417	Dep.(mc); $2.60(fs), $0.89(mf) OTS
71133	17-14646	Dep.(mc); $1.10(fs), $0.80(mf) OTS
72285	17-15521	Dep.(mc); $1.60(fs), $0.80(mf) OTS
73697	17-14766	Dep.(mc); $1.10(fs), $0.80(mf) OTS
73759	17-14782	Dep.(mc); $1.10(fs), $0.80(mf) OTS
73933	17-15522	Dep.(mc); $2.60(fs), $0.83(mf) OTS
74572	17-14418	Dep.(mc); $1.10(fs), $0.80(mf) OTS
74705	17-15489	Dep.(mc); $6.60(fs), $2.18(mf) OTS
74927	17-15523	Dep.(mc); $1.60(fs), $0.80(mf) OTS
75139	17-15490	Dep.(mc); $1.10(fs), $0.80(mf) OTS
76138	17-13877	Dep.; $1.00(OTS)
76389	17-14205	Dep.(mc); $1.60(fs), $0.80(mf) OTS
HW-SA–		
1821	17-14469	Dep.(mc); $3.60(fs), $1.19(mf) OTS
2570	17-13917	Dep.(mc); $1.10(fs), $0.80(mf) OTS
2588	17-13966	Dep.(mc); $1.10(fs), $0.80(mf) OTS
2605	17-13918	Dep.(mc); $1.10(fs), $0.80(mf) OTS
2613	17-13919	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2626	17-13920	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2653	17-13882	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2679	17-14783	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2682	17-14784	Dep.(mc); $2.60(fs), $0.89(mf) OTS
2683	17-14785	Dep.(mc); $2.60(fs), $0.95(mf) OTS
2790	17-13940	Life Sci. No. 12: 669-75(1962)
2798	17-14473	Dep.(mc); $4.60(fs), $1.43(mf) OTS
2809	17-14527	Dep.(mc); $5.60(fs), $1.91(mf) OTS
2849	17-14647	Dep.(mc); $2.60(fs), $0.83(mf) OTS
2856	17-14595	Dep.(mc); $2.60(fs), $0.95(mf) OTS
2862	17-14528	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2879	17-13921	Dep.(mc); $3.60(fs), $1.37(mf) OTS
2890	17-14474	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2901	17-15254	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2907	17-15393	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2917	17-14892	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2930	17-14419	Dep.(mc); $1.60(fs), $0.80(mf) OTS
IA–	**(Non-AEC)**	
744	17-14820	Dep.(mc)
748	17-13922	Dep.
750	17-14470	Dep.(mc)
777	17-14713	
781	17-14206	Dep.(mc)
782	17-14207	Dep.(mc)
IDO–		
14600	17-14767	Dep.; $0.50(OTS)
14601	17-15524	Dep.; $1.50(OTS)
16728	17-15498	Dep.; $2.25(OTS)
16839	17-14311	Dep.; $0.50(OTS)
24034	17-15455	Dep.(mc); $6.60(fs), $2.09(mf) OTS
24034(Add.)	17-15456	Dep.(mc); $5.60(fs), $1.73(mf) OTS
24034(Add.2)	17-15457	Dep.(mc); $10.10(fs), $3.86(mf) OTS
IEA–	**(Non-AEC)**	
56	17-14139	Dep.(mc)
IGO-TM–	**(British)**	
CA.010	17-14734	Dep.(mc)
IKF–	**(German)**	
6	17-14648	Dep.(mc)
IR–	**(Non-AEC)**	
62-3	17-14835	See NP-12520
IS–		
436	17-15001	Proc. Roy. Soc. (London) Ser. A 271: 88-104(1963)
475	17-15255	Dep.(mc); $2.60(fs), $0.92(mf) OTS
513	17-14821	Dep.(mc); $1.60(fs), $0.80(mf) OTS
528	17-14255	Inorg. Chem. 2: 50-3(1963)
587	17-14450	Dep.; $0.75(OTS)
622	17-14208	Dep.(mc); $1.10(fs), $0.80(mf) OTS
623	17-14936	Dep.(mc); $1.60(fs), $0.80(mf) OTS
JEN–	**(Spanish)**	
110-SIG-12	17-14372	Dep.(mc)
JINR–	**(Russian)**	
D-1090	17-15075	Dep.(mc)
P-1019	17-15076	Dep.
P-1106	17-15077	Dep.(mc)
JPRS–	**(Non-AEC)**	
17202	17-14089	$1.60(OTS)
17222	17-14092	$3.60(OTS)
17446	17-14863	$2.75(OTS)
17684	17-14125	$1.25(OTS)
17750	17-14864	$1.00(OTS)
17819	17-13988	$1.00(OTS)
17872	17-14095	$0.50(OTS)
KAPL–		
902	17-14596	Dep.(mc); $2.60(fs), $0.95(mf) OTS
KFK–	**(German)**	
123	17-14295	Z. Anorg. Allgem. Chem. 317: 241-4 (1962)
124	17-13893	Arzneimittel-Forsch. 12: 924-30(1962)
KR–	**(Norwegian)**	
31	17-14735	Dep.(mc)
33	17-14786	Dep.(mc)
34	17-15458	
36	17-13878	Dep.(mc)
LA–		
2802	17-15345	Dep.; $3.00(OTS)
2811	17-15256	Dep.; $1.25(OTS)
2828	17-14209	Dep.; $3.60(fs), $1.16(mf) OTS

Report No.	Abstract No.	Availability
LADC–		
3670	17-14256	Inorg. Chem. 2: 53-7(1963)
4796	17-14082	See TID-13613
5194	17-14661	Health Phys. 9: 31-9(1963)
5340	17-15346	Dep.(mc); $3.60(fs), $1.28(mf) OTS
5346	17-14252	Inorg. Chem. 2: 1-5(1963)
5371	17-14288	Spectrochim. Acta 19: 329-38(1963)
5404	17-14974	J. Chem. Phys. 38: 836-9(1963)
5411	17-14937	Dep.(mc); $5.60(fs), $1.79(mf) OTS
5428	17-14822	Dep.(mc); $2.60(fs), $0.83(mf) OTS
5452	17-14257	Inorg. Chem. 2: 58-61(1963)
5472	17-14938	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5575	17-14823	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5615	17-14824	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5634	17-14376	Dep.(mc); $1.10(fs), $0.80(mf) OTS
5639	17-14714	Dep.(mc); $1.60(fs), $0.80(mf) OTS
LAMS–		
2797	17-14420	Dep.; $0.75(OTS)
2800	17-15375	Dep.; $0.75(OTS)
LAR–		
12	17-14825	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14	17-14826	Dep.(mc); $1.60(fs), $0.80(mf) OTS
17	17-14827	Dep.(mc); $2.60(fs), $0.89(mf) OTS
19	17-14805	See ARF-2158-12
21	17-14724	See ARF-2158-15
44	17-14806	See ARF-2158-18
45	17-14807	See ARF-2158-21
46	17-14808	See ARF-2158-24
LAS-SR–		
161-55	17-14576	See TID-17973
LNF–	(Italian)	
62/8	17-15319	Dep.(mc)
62/58	17-14939	Dep.(mc)
62/60	17-14649	Dep.(mc)
62/67	17-15320	Dep.(mc)
LTEC-PR–		
16	17-14301	For translation see AEC-tr-5641
M–	(Misc.)	
274*	17-15081	See NP-12588
292	17-15323	See TID-15917
MATT–		
135	17-15347	Dep.(mc); $2.60(fs), $0.83(mf) OTS
152	17-15348	Dep.; $1.00(OTS)
MF–	(Misc.)	
33	17-15349	See NYO-9754
ML–	(Misc.)	
504	17-15324	See TID-16591
919	17-15351	See TID-16057
961	17-15352	See TID-17791
MPR-XIII–		
1-63	17-14457	See TID-18006
MRC–	(Misc.)	
287	17-14845	See TID-15434
MRL-TDR–	(Non-AEC)	
62-29	17-14529	$1.75(OTS)
62-46	17-14530	$0.50(OTS)
MSAR–	(Misc.)	
63-33	17-14768	Dep.(mc); $3.60(fs), $1.40(mf) OTS
N–	(Misc.)	
62-10124*	17-13916	See ARF-3170-6
62-10946*	17-15512	$2.60(fs), $0.92(mf) OTS
62-11035*	17-15376	$10.50(fs), $4.13(mf) OTS
62-11131*	17-15513	$6.60(fs), $2.21(mf) OTS
62-11274*	17-14897	See RAI-305
62-11513*	17-14818	See DRI-2039
62-11516*	17-14140	$1.60(fs), $0.80(mf) OTS
62-12405*	17-14923	See AASU-213
62-12535*	17-15342	See AD-275762
NAA-SR-Memo–		
7403	17-14597	Dep.(mc); $3.60(fs), $1.37(mf) OTS
7512	17-15459	Dep.(mc); $1.10(fs), $0.80(mf) OTS
7524	17-14451	Dep.(mc); $2.60(fs), $0.95(mf) OTS
7527	17-15460	Dep.(mc); $1.10(fs), $0.80(mf) OTS
7577	17-15394	Dep.(mc); $1.10(fs), $0.80(mf) OTS
7673	17-15461	Dep.(mc); $1.10(fs), $0.80(mf) OTS
7675	17-15068	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7676	17-15462	Dep.(mc); $2.60(fs), $0.86(mf) OTS
7723	17-15395	Dep.(mc); $7.60(fs), $2.48(mf) OTS
7776	17-15215	Dep.(mc); $4.60(fs), $1.52(mf) OTS
7813	17-15396	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7815	17-14122	Dep.(mc); $2.60(fs), $0.98(mf) OTS
7824	17-14715	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7832	17-14828	Dep.(mc); $1.10(fs), $0.80(mf) OTS
7839	17-14736	Dep.(mc); $6.60(fs), $2.24(mf) OTS
7871	17-14829	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7872	17-14893	Dep.(mc); $2.60(fs), $0.92(mf) OTS
NASA-TN–	(Misc.)	
D-1547*	17-15053	$0.50(OTS)
D-1575*	17-15397	$0.75(OTS)
D-1686*	17-14940	$0.50(OTS)
D-1717*	17-15054	$0.50(OTS)
NBS–	(Misc.)	
7608	17-14941	Dep.(mc); $1.60(fs), $0.80(mf) OTS
NBS-MON–	(Misc.)	
25(Sect.1)*	17-14210	$0.40(GPO)
NCSC–	(Misc.)	
2663-9	17-14830	Dep.(mc); $2.60(fs), $1.10(mf) OTS
NDA-Memo–	(Misc.)	
2126-2	17-15398	Dep.(mc); $3.60(fs), $1.40(mf) OTS
NDL-TR–	(Non-AEC)	
32	17-14531	$13.50(OTS)
NIRL-M–	(British)	
21	17-15321	Dep.(mc)
NLCO–		
866	17-14141	Dep.(mc); $2.60(fs), $0.92(mf) OTS
868	17-14716	Dep.(mc); $2.60(fs), $0.98(mf) OTS
NMI–	(Misc.)	
1248	17-14787	Dep.; $2.75(OTS)
1255	17-14894	Dep.(mc); $3.60(fs), $1.28(mf) OTS
1908	17-14769	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2111	17-14831	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2800	17-14832	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7016	17-14833	Dep.(mc); $2.60(fs), $1.04(mf) OTS
7215A	17-14895	Dep.(mc); $2.60(fs), $0.98(mf) OTS
7215BC	17-14896	Dep.(mc); $2.60(fs), $0.98(mf) OTS
7258	17-14737	Dep.(mc); $1.60(fs), $0.80(mf) OTS
9525*	17-14738	
9700.6	17-14788	
9805*	17-14834	

Report No.	Abstract No.	Availability
NMI-TJ–		
52	17-14894	See NMI-1255
NP–	**(AEC File No. for Non-AEC Reports)**	
12255	17-14475	
12440	17-15399	Dep.(mc)
12484	17-13967	$12.00(OTS) as AD-295864
12486	17-15525	
12502	17-15216	Dep.
12513	17-14532	Dep.(mc); $18.00(fs), $8.75(mf) OTS
12520	17-14835	
12525	17-14739	
12528	17-14942	Dep.(mc)
12531	17-15499	Dep.(mc)
12534	17-14533	$5.60(OTS) as AD-296812
12535	17-13978	$1.10(OTS) as AD-296291
12544	17-15400	
12553	17-15401	Dep.(mc)
12554	17-15402	Dep.(mc)
12555	17-15403	
12556	17-15404	
12557	17-15405	
12558	17-15406	Dep.(mc)
12559	17-15407	Dep.(mc)
12560	17-15408	Dep.(mc)
12561	17-15409	Dep.(mc)
12563	17-15410	Dep.(mc)
12564	17-15411	Dep.(mc)
12565	17-15078	Dep.(mc)
12566	17-15079	Dep.(mc)
12567	17-15080	Dep.(mc)
12578	17-14452	Dep.(mc)
12581	17-14534	Dep.(mc); 2s. (HMSO)
12588	17-15081	
12590	17-14535	$1.10(OTS)
12592	17-14836	
12593	17-14598	
12594	17-14476	
12595	17-14837	
NP-tr–	**(AEC File No. for Non-AEC Translations)**	
949	17-15092	Dep.(mc)
950	17-15093	Dep.(mc)
NRL–	**(Misc.)**	
5807*	17-14599	$0.75(OTS)
5869*	17-14477	$1.60(OTS)
5880*	17-14838	$0.50(OTS)
5904*	17-14839	
NSEC–		
62	17-14478	Dep.(mc); $4.60(fs), $1.61(mf) OTS
80	17-14479	Dep.(mc); $2.60(fs), $0.83(mf) OTS
NSEC(T)–		
15	17-14377	Dep.(mc); $3.60(fs), $1.16(mf) OTS
18	17-14211	Dep.(mc); $1.60(fs), $0.80(mf) OTS
NUMEC-P–		
46	17-14840	Dep.(mc); $3.60(fs), $1.31(mf) OTS
NYO–		
9289	17-15082	Dep.(mc); $1.10(fs), $0.80(mf) OTS
9458	17-14841	Dep.(mc); $3.60(fs), $1.16(mf) OTS
9754	17-15349	Dep.(mc); $1.60(fs), $0.80(mf) OTS
9812	17-14943	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10010	17-14600	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10011	17-14601	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10012	17-14602	Dep.(mc); $2.60(fs), $1.10(mf) OTS
10077	17-14603	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10078	17-14604	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10079	17-14605	Dep.(mc); $2.60(fs), $1.01(mf) OTS
10088	17-14944	Dep.; $2.75(OTS)
10144	17-14575	Dep.(mc); $1.10(fs), $0.80(mf) OTS
10255	17-14945	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10456	17-14789	Dep.(mc); $9.60(fs), $3.59(mf) OTS
10535	17-14212	Dep.(mc); $4.60(fs), $1.49(mf) OTS
ORNL–		
3278	17-14213	Dep.; $0.50(OTS)
3304	17-14214	Dep.; $4.60(fs), $1.70(mf) OTS
3365	17-15322	Dep.; $1.00(OTS)
3378	17-14606	Dep.; $2.25(OTS)
3389	17-14312	Dep.; $0.75(OTS)
3396	17-14842	Dep.; $3.60(fs), $1.22(mf) OTS
3406	17-15377	Dep.; $0.50(OTS)
ORNL-TM–		
378	17-15500	Dep.(mc); $5.60(fs), $1.79(mf) OTS
395	17-14378	Dep.(mc); $1.60(fs), $0.80(mf) OTS
446	17-14790	Dep.(mc); $2.60(fs), $0.95(mf) OTS
460	17-14843	Dep.(mc); $3.60(fs), $1.13(mf) OTS
461	17-15217	Dep.(mc); $8.60(fs), $3.11(mf) OTS
470	17-15069	Dep.(mc); $1.60(fs), $0.80(mf) OTS
OTS–		
63-21221	17-14095	For translation see JPRS-17872
OU-LNS–	**(Japanese)**	
62-01	17-14946	Dep.(mc)
PAN–	**(Polish)**	
343/IX	17-14453	Dep.(mc)
353/I-A	17-15218	Dep.
355/I-B	17-15219	Dep.
361/IV	17-14373	Dep.
362/IV	17-14215	Dep.
366/VII	17-15083	Dep.
368/VII	17-15084	Dep.
369/VII	17-15085	Dep.
370/VIII	17-14142	Dep.
PATENTS	**(Canadian)**	
651,277	17-15438	
652,609	17-14374	
652,712	17-15439	
652,721	17-15440	
PATENTS	**(German)**	
1,066,555	17-14707	For French translation see CEA-tr-A-1164
1,076,093	17-14226	For French translation see CEA-tr-A-1227
PG-Report–	**(British)**	
392	17-14143	Dep.
400	17-14144	Dep.; $0.35(BIS); 2s. 6d. (HMSO)
410	17-14145	Dep.; $0.21(BIS); 1s. 6d. (HMSO)
411	17-14146	Dep.
412	17-14147	Dep.; $0.31(BIS); 2s. 3d. (HMSO)
416	17-14148	Dep.
419	17-14149	Dep.; $0.56(BIS); 4s. (HMSO)
PPAD–		
461-E	17-14678	Nucl. Instr. Methods 21: 126-8(1963)
PUC–		
1963-96	17-15257	Dep.(mc); $18.00(fs), $8.69(mf) OTS
R–	**(Misc.)**	
1297-9*	17-15513	See N62-11131
RAI–	**(Misc.)**	

Report No.	Abstract No.	Availability
305*	17-14897	$10.10(fs), $4.07(mf) OTS
REIC-Access–	**(Non-AEC)**	
60	17-14898	
RFP–		
302	17-14421	Dep.; $0.50(OTS)
RM–	**(Misc.)**	
3144-PR*	17-15055	$3.60(OTS)
3386-PR*	17-14480	$1.60(OTS)
3440-PR*	17-15350	$2.60(OTS)
RS-L–	**(British)**	
16	17-14642	See AEEW-M-281
RT-ING–	**(Italian)**	
(62)-1	17-14422	Dep.(mc)
(62)-12	17-15412	Dep.
(62)-13	17-15463	Dep.(mc)
SB–	**(Non-AEC)**	
447(Rev.)	17-14300	$0.10(OTS)
SC–	**(Misc.)**	
4752(RR)	17-14454	Dep.; $0.50(OTS)
4759(RR)	17-14947	Dep.; $0.50(OTS)
SCDC–		
2721	17-14791	See TID-16307
2731	17-14486	See TID-16194
SCNC–	**(Misc.)**	
269	17-14844	Dep.(mc); $1.60(fs), $0.80(mf) OTS
SCPRI(A)–	**(French)**	
83	17-14536	Dep.(mc)
SCPRI(M)–	**(French)**	
62-11	17-14537	Dep.(mc)
SCPRI(RM)–	**(French)**	
62-12	17-14538	Dep.(mc)
SCR–		
563	17-14720	See TID-15455
579	17-14486	See TID-16194
SL–	**(Misc.)**	
1812	17-15464	Dep.(mc); $10.50(fs), $4.13(mf) OTS
1974-3	17-15465	Dep.(mc); $11.00(fs), $4.55(mf) OTS
SM–	**(Misc.)**	
38/17	17-14473	See HW-SA-2798
39/20	17-14527	See HW-SA-2809
SRIA–		
101	17-14313	Dep.(mc); $4.60(fs), $1.49(mf) OTS
SRO–		
77	17-15466	Dep.(mc); $1.10(fs), $0.80(mf) OTS
STI-PUB–	**(International Atomic Energy Agency)**	
26	17-14573	$1.50(IAEA)
62(Vol.I)	17-15228	$9.00(IAEA)
TF–	**(Non-AEC)**	
6	17-15092	For translation see NP-tr-949
8	17-15093	For translation see NP-tr-950
TID–		
3561(Rev.3)	17-15413	Dep.; $1.50(OTS)
11295(2nd Ed.)	17-14740	Dep.; $5.50(OTS)
13613	17-14082	p.233-9 of "Mathematical Problems in the Biological Sciences." American Mathematical Society, 1962
15234	17-15194	See BNL-719(Vol.III)(p.900-31)
15412	17-15164	See BNL-719(Vol.I)(p.100-16)
15434	17-14845	Dep.(mc); $4.60(fs), $1.61(mf) OTS
15437	17-15414	Dep.(mc); $2.60(fs), $0.98(mf) OTS
15455	17-14720	Biometrika 49: 433-45(1962)
15615	17-14948	Dep.(mc); $2.60(fs), $1.10(mf) OTS
15842	17-14150	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15917	17-15323	Dep.(mc); $6.60(fs), $2.21(mf) OTS
15970	17-14770	Dep.(mc); $2.60(fs), $1.07(mf) OTS
16057	17-15351	Dep.(mc); $1.60(fs), $0.80(mf) OTS
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